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Bethesda, Maryland 20084

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ELECTRICAL/ELECTRONICS ENGINEERING ANALYSIS

by

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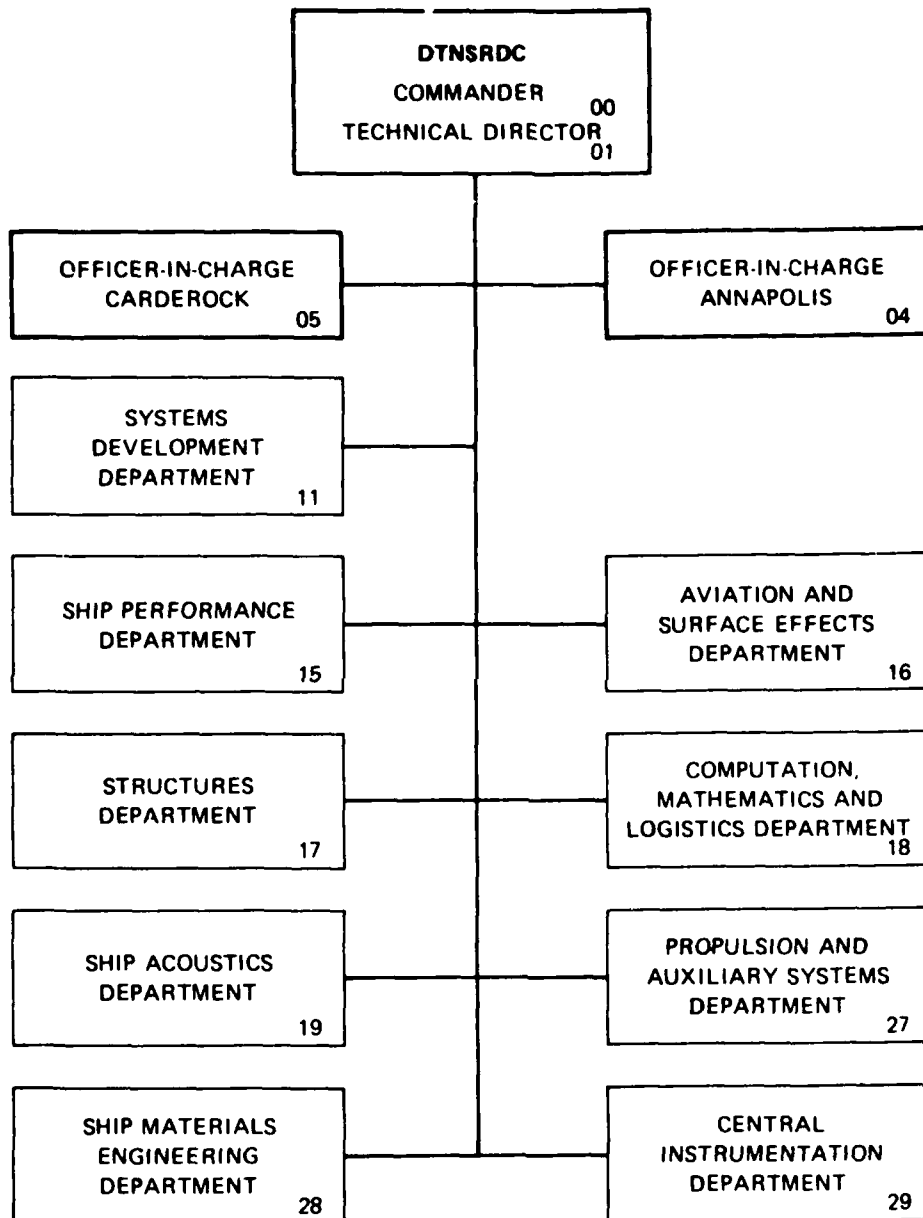ELECTRICAL/ELECTRONICS ENGINEERING ANALYSIS

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This report provides an engineering analysis of the electrical/electronic process as it applies to the design, planning, and construction of naval ships and presents the results of the analysis in a form which will provide guidance for the development of a computer-aided electrical/electronic design and construction system (ELXDAC). This engineering analysis discusses the implementation of the electrical/electronic design in a computer-based environment. Functional descriptions of the various application programs and subsystems to be developed are included.

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ABSTRACT

This report provides an engineering analysis of the electrical/
electronic process as it applies to the design, planning, and con-
struction of naval ships and presents the results of the analysis in
a form which will provide guidance for the development of a computer-
aided electrical/electronic design and construction system (ELXDAC).

This engineering analysis discusses the implementation of the
electrical/electronic design in a computer-based environment.
Functional descriptions of the various application programs and
subsystems to be developed are included.

ADMINISTRATIVE NOTE

The work described in this report was performed under the NAVSEA Computer-
Aided Ship Design and Construction (CASDAC) program. This project envisaged
CASDAC to be divided into two parts:

> (A) Early-Stage through Contract Ship
>   Design as performed and developed in-
>   house by NAVSEA.
>
> (B) Detail Design and Construction as
>   performed in public and private ship-
>   yards. This part was to be managed
>   by NAVSEA with guidance from the ship-
>   yards, and the detail work was planned
>   to be performed by the shipyards under
>   contract to the Navy. Guidance was
>   planned to be developed under a series
>   of discipline-oriented Navy-Industry
>   committees.

Planning under Part (B) in piping design progressed under a Navy-Industry
piping committee, and some software was procured and distributed. A Navy-
Industry electrical/electronics committee has not been established. The
report herewith was intended to be the first document to be considered by
such a committee.

Funding for CASDAC in recent years has been uncertain and intermittent,
especially for Part (B) of the program. This part is currently not funded,
and, indeed, substantial administrative changes to the program have been in
progress for the past 18 months. This current environment of change is to
be borne in mind when reading the program plans described in the report.

I. INTRODUCTION

A. BACKGROUND

The Navy has begun developing a comprehensive integrated computer-aided ship design and construction system (CASDAC). This is a significant software development that is expected to extend over a number of years. The project can be thought of as a progression from the current use of individual stand-alone computer programs for separate computational and design tasks to the future implementation of a fully integrated CASDAC system. The Navy has also developed integrated system software that will support such systems as CASDAC.

The total CASDAC system will evolve around the development of several subsystems that will gradually be interfaced with each other. These will include, among others, subsystems for

> hull structure,
> electrical/electronic systems,
> machinery,
> piping,
> heating/ventilation/air-conditioning,
> handling, and
> arrangements.

One of these systems to be developed is the Electrical/Electronic Design and Construction System, ELXDAC. ELXDAC is a computer-based system for the design, planning, and installation of Naval Shipboard Electrical/ Electronic Systems. It may be described as a systematic assembly of hardware and computer programs by which shipyard and design agent personnel can design, analyze, optimize, arrange, detail, procure, and schedule electrical systems. The ELXDAC system is further described in this Engineering Analysis.

A similar engineering analysis was developed for the piping process—"Engineering Analysis of the Piping Process for Naval Ship Design, Planning, and Construction," David Taylor Naval Ship R&D Center Report CMD-7-75, June 1975.

B. SCOPE OF ELXDAC

The Naval Sea Systems Command (NAVSEA) is responsible for acquisition of ships for the U.S. Navy. In fulfilling this responsibility the Navy must perform ship design in sufficient detail to assure acquisition of ships that will meet the performance requirements of the fleet. Electrical/electronic systems are a vital part of all ships and represent a substantial portion of the ship design effort and construction process.

The names and functional definitions of the ship design and construction processes change from time to time. As a result the processes are identified by level numbers. The following summary provides a brief description of the overall process which also applies to the electrical process which ELXDAC will encompass.

LEVEL I   - Corresponds to concept exploration, the first part of the conceptual
            phase, or concept formulation.

LEVEL II - Corresponds to concept development, the second part of the conceptual
            phase, preliminary design or allocated baseline design.

LEVEL III - Is the validation/ship system design phase, contract definition or
            contract design phase in which contract plans and specifications are
            generated for the solicitation of bids.

LEVEL IV - Comprises detail design, which involves the selection and arrangement
            of all ship components; design of all details; development of working
            and fabrication drawings, material lists and all information required
            for ship construction; installation of all components; and testing
            and trial procedures.

LEVEL V   - Covers ship construction

     ELXDAC will address the computerization of the electrical process involving
the following elements. The numbers correspond to those in Figure I-1.

     (1) Management: This is the decision-making process at all levels of an
organization which effectively plans, sequences, controls, and measures the
shipbuilding process.

     (2) Ship requirements and ship specifications: These are the basic
requirements set forth for the design and construction of the electrical systems.
They describe to varying degrees of detail the constraints under which the ship
is constructed.

     (3) Design functions: These functions involve specifying the electrical
requirements and configuration for Levels II, III, and IV.

     (4) Planning functions: These functions include delineating work packages;
assigning trades; scheduling; and procuring material.

     (5) Production functions: These functions include fabrication, installa-
tion, and testing of electrical systems.

     (6) Data base: The data base comprises all the information resources
available to the design, planning, and shop personnel. It includes general speci-
fications, drawings, military specifications, design data sheets, catalogs,
instructions, shop practices, etc.

     (7) Ship file: This file contains the aggregation of information developed
for a particular ship.

     The relationships among the elements described above are highly interactive.
A simplistic view of the electrical process is shown in Figure I-1 with management
as the central control. At the detail working level interaction occurs directly
among various elements; for example, a designer will obtain information from the

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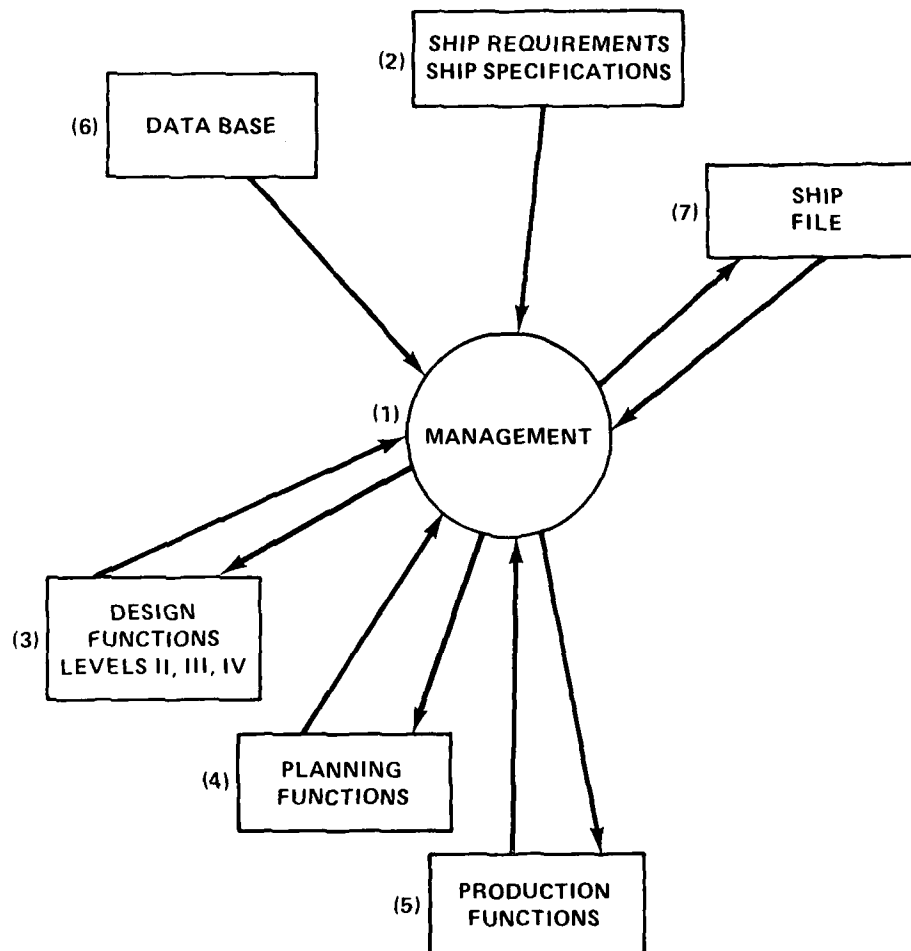
Figure I-1   Overview of the Manual Electrical Process

data base to prepare a drawing without management approval. However, his final product, the drawing, is subject to management review and control as is the data base. Management is involved in the sequence and control of events.

At several shipyards the existing electrical process is currently supported by several application programs that are run as stand-alone programs (programs such as these will be used in the development of the ELXDAC system). They have proved to be effective and cost-saving elements within the current electrical process. Examples of such programs include:

- Design
  - Load Analysis
  - Fault Current Calculations
  - Voltage Drop Calculations
  - Preparation of Material Lists

- Planning
  - Management Information Systems

- Construction
  - Data Generation for Cable Hookup

C. ELXDAC USERS

The ELXDAC system proposed herein is for discussion with and possible eventual use by U. S. naval and private shipyards and design agents. Practices in the electrical process differ among these organizations, particularly in planning and construction. These differences involve nomenclature, trade cognizance, formats of data and reports, types of documents used, and other differences.

II. OBJECTIVES AND GOALS

A. OBJECTIVE

This report provides the results of an engineering analysis of the electrical process as it applies to the design, planning, and construction of naval ships. It presents these results in a form which will provide guidance for the development of a computer-aided electrical design and construction system. The analysis will result in:

- Definition of a digital model for electrical systems (Ship Master File).

- Definition of the process to create the model and to provide output from the model.

- Definition of the data base to support the electrical process.

- An accounting of the data relationships and flow of data in the system. See Figure II-1.

- Development of computer program and subsystem functional descriptions.

- Development of a schedule for computer program development.

This analysis does not require the development of computer programs or the gathering of data for the data base.

B. GOALS

Several classes of goals are involved in the development of ELXDAC.

1. General:

- Reduce design manpower requirements

- Reduce errors

- Reduce costs

- Reduce construction time

- Provide better designs

- Provide better management and design review controls

2. Developmental

ELXDAC is to be developed in a manner compatible with a complete ship integrated design and construction system. Subsystems to be integrated include hull structure, piping systems, arrangements, ventilation, etc. It must:
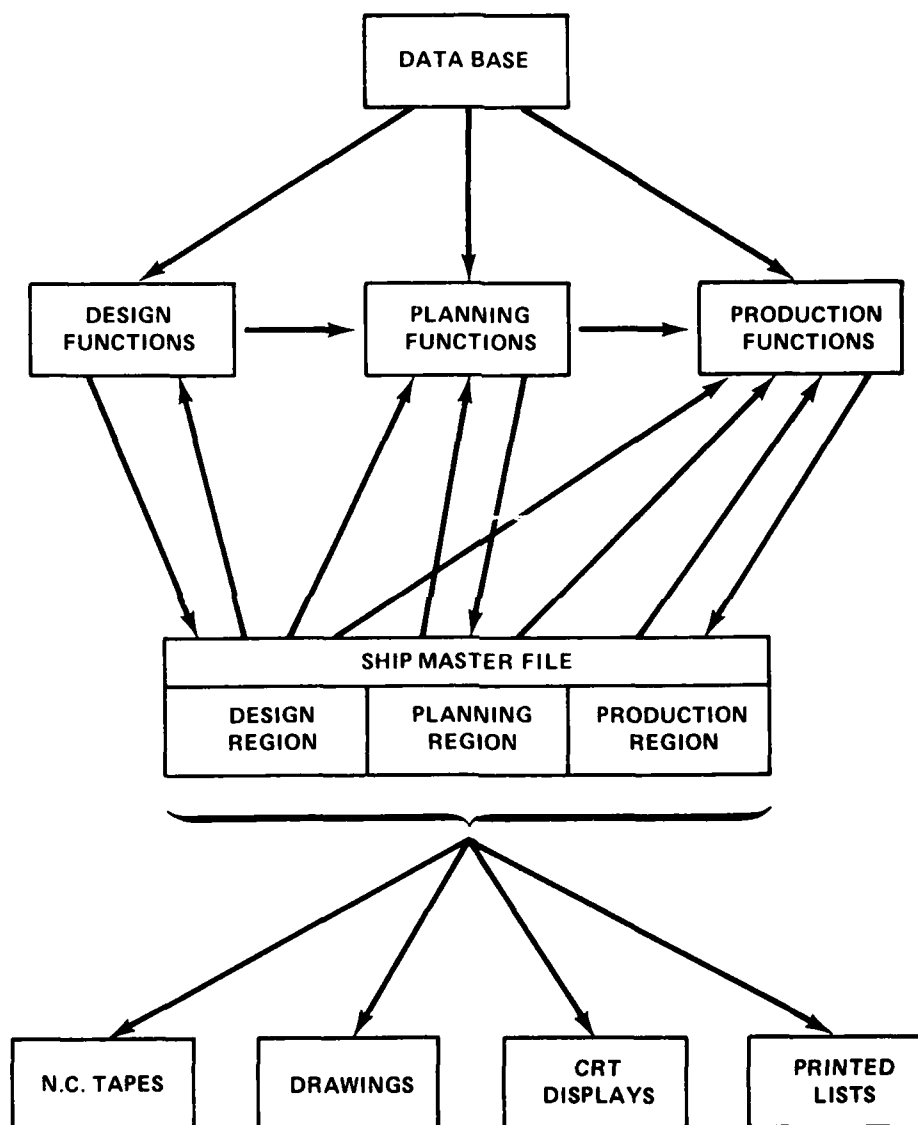
Figure II-1   Basic Flow of Information Through ELXDAC

- Communicate and share data

- Provide executive and administrative controls for orderly progression of design

- Standardize methods of storing data - especially graphical descriptions

- Develop software of general utility where possible (e.g., consider piping related to wire networks, etc.)

3. Industry-Related

- Produce a final product that will be accepted and used by most shipbuilders.

- Develop systems in modular fashion for early use and acceptance of modules.

- Involve Industry in the planning, development, and implementation of modules.

C. IMPLEMENTATION OF GOALS

1. Areas of Involvement

The Navy/Industry relationship is an important factor in the development and implementation of ELXDAC. In this context industry includes both Naval and private shipyards and ship design agents who are to be the ultimate users of ELXDAC. Five separate factors are involved in this relationship:

    a. The roles which Navy and Industry are to play in the planning, development, and implementation of ELXDAC

    b. The phases of ELXDAC development

    c. The Navy/Industry Advisory Committee

    d. The Industry consultants

    e. Workshops

2. The Roles of Navy and Industry

The Naval Sea Systems Command and the David Taylor Naval Ship Research and Development Center will provide overall CASDAC/ELXDAC management guidance.

The Naval Ship Research and Development Center, Computer-Aided Design Division, is the technical manager, and will be engaged in the development of an ELXDAC system, and will implement the application programs developed by industry into an integrated system. They will also evaluate hardware suitable for the ELXDAC system, develop system software, establish a test bed data base, engage in human engineering studies, and validate the integrated system.

The Navy role will involve the formulation of the ELXDAC system, a survey of the shipbuilding industry regarding its opinions on the development of ELXDAC and the establishment of a Navy/Industry Committee to guide the development of ELXDAC.

The shipbuilding industry, including naval shipyards, under contract to the Navy, will develop the application programs in design, planning, and construction; establish a catalog file of engineering and technical data; document, validate, maintain and distribute programs and train users.

Figure II-2 depicts the relationships and functions of the Navy/Industry team.

The rationale for this distribution of effort between Navy and Industry is based on capabilities and user involvement. This capability, and the NSRDC personnel who developed it, will be utilized in the development of the ELXDAC system.

The shipbuilding industry, the ultimate users of ELXDAC, has an interest in the development of a system which will be useful to them. Their capabilities and detailed knowledge of the shipbuilding industry will be used in three ways:

- To develop the application programs and data base to be used in ELXDAC

- As members of the Navy/Industry Committee, to provide guidance to the Navy in developing ELXDAC

- As consultants in design, planning, and construction, to critique and provide input during the planning stages of ELXDAC

3. Phases of Development

It is planned to proceed with the development of ELXDAC in five phases.

PHASE I - Perform an engineering analysis of the electrical process (which is the subject of this report). As part of this work the total electrical process will be reviewed (design, planning, construction) and the computer programs that will be defined in the analysis will be divided into four groups. Each group shall be of approximately equal level of effort. Each group is to represent a priority level, starting with the first group as first priority. Determination of priority shall take into account:

a. The cost benefits to be realized within the scope of the total electrical process

b. The nature and extent of the data base required to support the program

c. The interface requirements of the integrated ELXDAC system

d. The needs of the shipbuilding community - private and naval - and design agents

PHASE II - Develop, under contract, the first group of programs. As a minimum, collect and structure the data base necessary to support the program. However, it may

ELXDAC FORMULATION (DTNSRDC)
INDUSTRY SURVEY (DTNSRDC)
LETTER TO INDUSTRY (DTNSRDC)
REPORT ON SURVEY: ESTABLISH COMMITTEE (DTNSRDC)

DTNSRDC

TECHNICAL MANAGEMENT AND
SYSTEM DEVELOPMENT
AND
SYSTEM IMPLEMENTATION

INDUSTRY

DEVELOPMENT OF:

APPLICATION PROGRAMS IN
DESIGN, PLANNING AND
CONSTRUCTION

CATALOG DATA

TECHNICAL INFORMATION
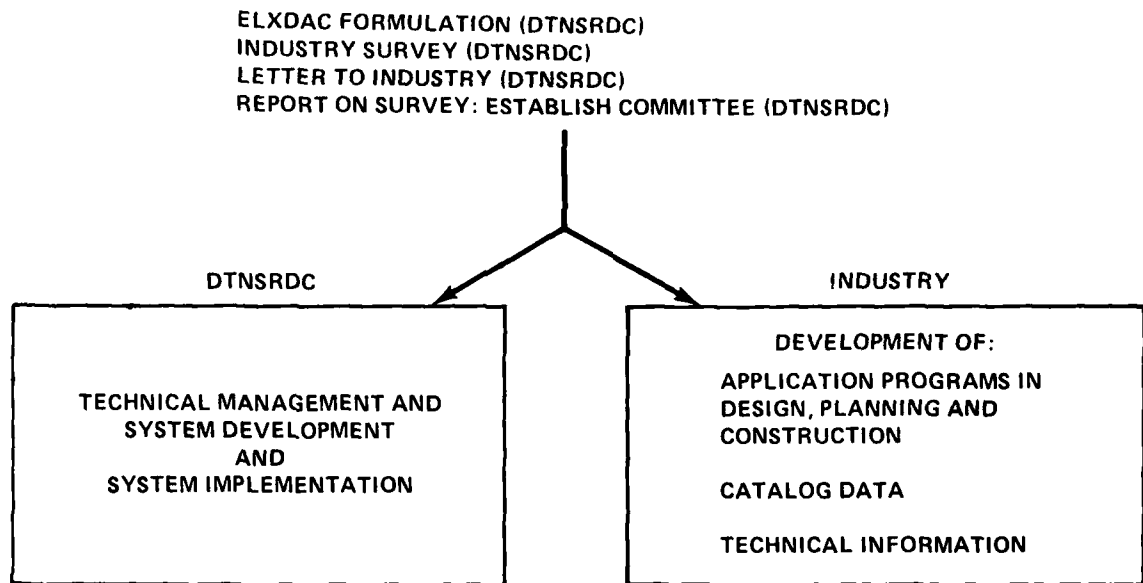
FUNCTIONS

HARDWARE DETERMINATION

SYSTEM SOFTWARE DEVELOPMENT

TEST BED DATA BASE DEVELOPMENT

HUMAN ENGINEERING

IMPLEMENTATION OF PROGRAMS
  DEVELOPED BY INDUSTRY

VALIDATION

FUNCTIONS

PROGRAM DEVELOPMENT

VALIDATION

DOCUMENTATION

DISTRIBUTE PROGRAMS

TRAINING USERS

Figure II-2   ELXDAC Functional Tasks

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be more cost-effective to collect the data for the entire project under one contract. Future funding may govern this.

PHASE III - Develop group 2 programs.

PHASE IV - Develop group 3 programs.

PHASE V - Develop group 4 programs.

4. The Navy/Industry Advisory Committee

A Navy/Industry ELXDAC Advisory Committee will be established to provide industry technical expertise and advice to the Navy in the development of ELXDAC.

5. Industry Consultants

DTNSRDC will obtain the services of industry consultants in developing the ELXDAC system.

6. Workshops

In July 1977, a workshop was held with representatives from DTNSRDC, NAVSEC, Avondale Shipyards, Electric Boat, Ingalls Shipyards, and George G. Sharp, Inc., to determine the engineering and planning functions performed by the shipyards during detail design. The workshop concept will continue to be used in the development of the ELXDAC system.

III. COMPUTER-BASED ENVIRONMENT

The purpose of this section is to describe the computer based environment which will be utilized in the development and implementation of the ELXDAC system.

The manual design process[1] has been translated into a computer-based environment. Sections IV and V of this report present the elements needed for the computerized design process.

The ELXDAC system will evolve in four forms:

● Stand-Alone Application Programs

Stand-alone application programs are those software programs such as "fault current" and "load analysis" which accomplish engineering calculations. Processing does not require special computer systems software. Only general software normally furnished with any second or third generation computer is necessary, such as a FORTRAN compiler and a loader. Approximately 20 programs of this type will be developed for ELXDAC. See Section V.

● Stand-Alone ELXDAC Subsystems

ELXDAC subsystems will require the support of some form of data management system and a support catalog. They will be characterized by:

●● A grouping of several electrical process functional tasks.

●● In some cases, the utilization of one or more application programs.

●● Interactive processing. Accomplishment of a sequence of data processing steps where results of one step influences subsequent steps or procedures. Man intervenes as required, using commands from terminals or on coded card instructions.

●● Utilization of peripheral devices such as digitizers, storage tubes, plotters, interactive graphics, mini-computers, etc.

●● Development in a series of modifications starting with minimal capabilities and progressing to more advanced capabilities.

●● Development for portability to easily adapt to commonly used computer configurations in naval and private shipyards and in the offices of design agents.

●● Development for adaptation to the ELXDAC integrated system.

----

[1]Computer-Aided Ship Design and Construction (CASDAC), Electrical/Electronic Detail Design Networks Report, George G. Sharp, Inc., October 1977.

Approximately 10 subsystems will be developed for ELXDAC. See Section IV. These subsystems, in total, comprise all the ELXDAC tasks planned for development at this time for design, planning, and production functions.

● The ELXDAC Integrated System

The ELXDAC Integrated System is comprised of a software and hardware system which includes a capability for multi-disciplinary users to generate a digital model from remote terminals. The users interact with the model, using computer programs and a data base, to create, modify and trade off designs which are used to produce output for the design planning and construction process. It will comprise all of the application programs and subsystems previously described.

● ELXDAC As a Subsystem of the CASDAC Integrated System

●● The CASDAC Integrated System will evolve around the development of several subsystems that will gradually be interfaced with each other. These will include, among others, subsystems for:

    hull structure,

    electrical/electronic systems,

    machinery,

    piping,

    heating/ventilation/air-conditioning, and

    handling.

●● ELXDAC is one of these systems to be developed.

Its initial development will be as described above. However, the full impact for the effective use of ELXDAC will be realized when all the CASDAC subsystems communicate with each other via an integrated environment. For example, the structural background and machinery arrangements will be displayable for routing cable. The piping, heating, ventilation and other systems competing for space within the volume of the ship will be effectively modeled for the detection of interferences with electrical/electronic components. They will also readily provide the interface requirements for electronic equipment, such as the water-cooling and foundation requirements.

●● The CASDAC Integrated System is similar in concept to the ELXDAC Integrated System which will be described in this report. Therefore, no description of the CASDAC environment will be given in this analysis.

There is a significant difference between "computer-aided" and "computerized," which leads into the area of true automation. Although ELXDAC is currently committed to the computer-aided aspects of design, planning and construction, several possibilities for automation exist. In the design area, the basic concepts for an automated routing scheme for cableways can be developed.

Documentation is the written record of all actions taken in the development of computer programs and systems. The various documents to be developed for the ELXDAC system are described in this report.

The sequence of development of the ELXDAC System is of significant importance. The application programs and subsystems will be developed first as stand-alone programs and systems for use in Industry. As they develop they will be implemented by the Navy into an ELXDAC integrated system. Implementation or availability of the ELXDAC software and hardware in the industry will permit users to utilize the advantages of an integrated system.

IV. ELXDAC SUBSYSTEMS

A. INTRODUCTION

The ELXDAC subsystems are comprised of the following stand-alone subsystems.

TITLE	SYSTEM DESIGNATOR
• Electrical Material Control System	G
• Label Plates	M
• Test Procedures	N
• Arrangement Drawings	F
• Ship Specification	C
• Documentation	A
• Interface Data	B
• Drawing and Material List	D
• Cabling and Wiring	J
• Scientific and Engineering	E

It is expected that each of these subsystems will be developed in a series of modifications (mods) that will provide increasing capabilities for the users. The capabilities of each subsystem will be greatly affected by the status and availability of the data base (i.e., application programs, catalog data, design guidelines and design data) that will be available at a point in time to support the subsystems. Also, the status of each individual subsystem will in some cases affect the development and utility of other subsystems.

B. LEVEL IV DESIGN SUBSYSTEMS

This subsection contains a description of each of the 10 ELXDAC Level IV design subsystems. Each subsystem is described in the same general format and is a self-contained document which can be used for guidance in preparing the contract specifications that will be required for development of the subsystems. The stand-alone subsystem descriptions given in this section consider the use of each of them as a totally independent subsystem.

1.   ELXDAC STAND-ALONE SUBSYSTEM "G"

TITLE: Electrical Material Control System

a.   Background

     The ELXDAC system comprises 10 stand-alone subsystems. Subsystem "G," "Electrical Material Control," is one of these systems.

     Although there may be some requirements in the Electrical Material Control Subsystem which are unique to the ELXDAC system, the requirements of this subsystem are basically common to the CAPDAC, HULDAC, CAMDAC and HVAC systems. In order to avoid duplication of effort, the development of the Electrical Material Control Subsystem will be a joint effort by the CASDAC systems.

     The integrated ELXDAC Electrical Material Control system is shown in Figure IV-G1.

     This system is a depository of current and latest material information regarding electrical/electronic equipment and cables available and/or committed to a particular ship or design. This system can also be used for:

     ● keeping records of transactions - names, dates, etc.

     ● maintenance of past transactions

     ● material changes related to change orders

b.   Objective

     The objective of this development is to permit a user engineer or designer to easily keep track of his material requirements and to assist him in keeping track of the events that affect his design. This is essentially a design-oriented system that will interface with planning, production, and supply. The principal users in terms of developing and updating the material files will be engineers and designers in a design organization. However, planners, shop personnel, supply personnel and others will interrogate the system and provide update information.

c.   Description of System

     The material control system is essentially a design-oriented system that will interface with existing planning, production, and supply systems. It is planned to perform the following functions:

     (1) Keep current the best estimates provided by design on material required
          for a ship/ships.

     (2) Provide means to perform trade-offs of material between systems on a ship
          and between multiple ships under construction.

Figure IV-G1
Sheet 1 of 2

SYMBOLS:

START OR COMPLETION OF A SERIES OF RELATED TASKS

OFF PAGE CONNECTORS- AA ARE TWO ALPHABETIC
CHARACTERS COMMON TO THE CONNECTION

HARD COPY DOCUMENTS-LISTS, REPORTS, DRAWINGS, ETC.

DATA FILES ON MAGNETIC MEDIA-TAPE OR DISK

COMPUTER SOFTWARE

TASKS-AS SPECIFIED WITHIN THE BLOCK
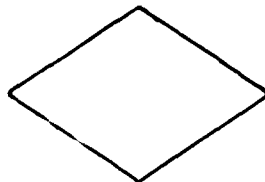
DECISIONS-AS SPECIFIED WITHIN THE BLOCK

Figure IV-G1   ELXDAC Stand-Alone Subsystem "G" Material Control
            Overview Chart

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Figure IV-G1
Sheet 2 of 2
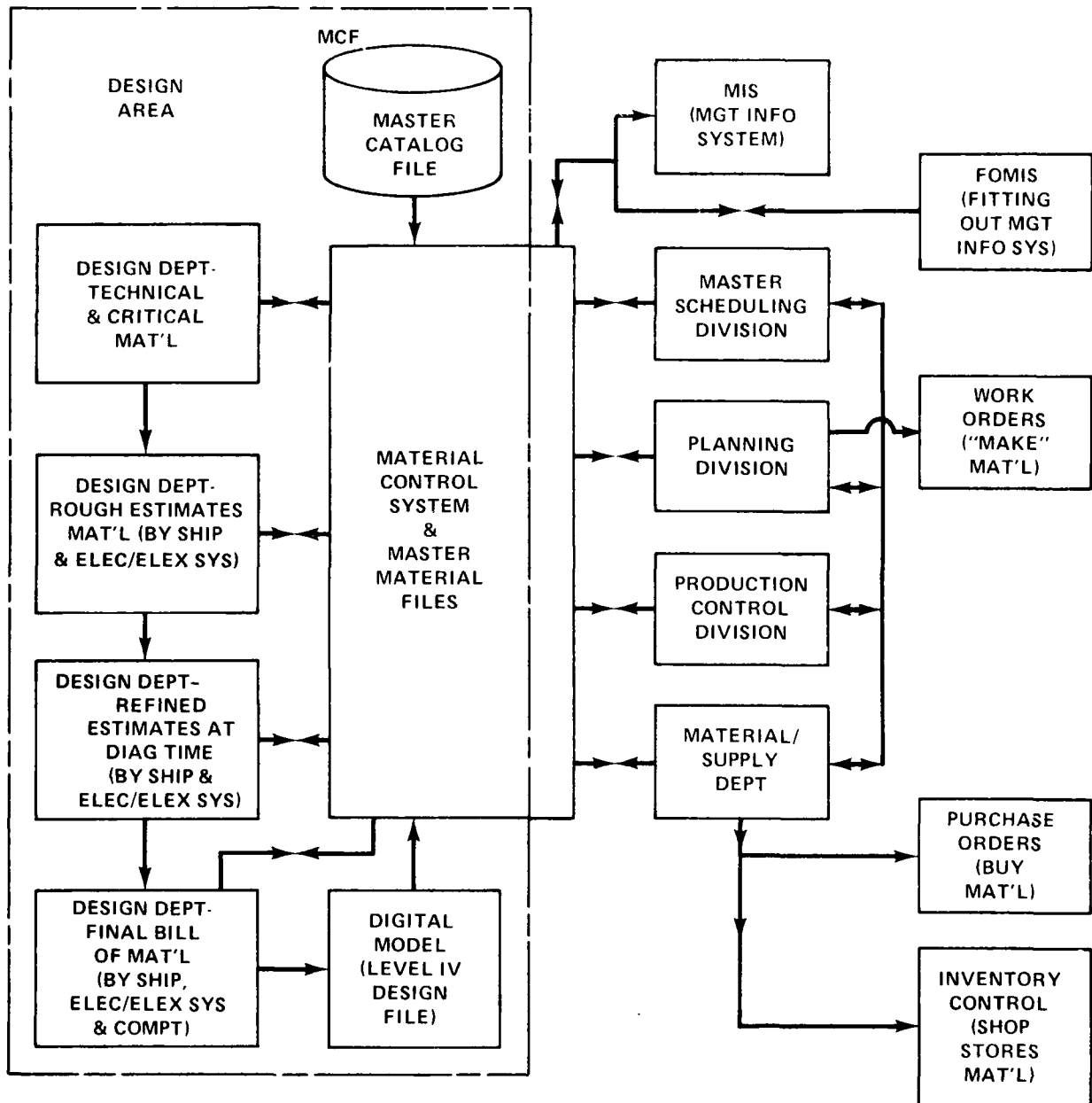
(3) Provide means to negotiate substitutions of material between Design/Engineering and other Departments.

(4) Keep current the status of material on order.

(5) Highlight differences between rough estimates of material, refined estimates and final bills of material as they are prepared to provide for adjudication of orders.

(6) Provide data for make-or-buy decisions.

(7) Coordinate/relate master ship construction schedules and material lead times to permit ordering on a timely scheduled basis.

(8) Permit summation and grouping of like items for bulk ordering and follow-on tracking of obligated uses.

(9) Invoke "MIC" for specified systems as per NAVSHIPS 0948-7010.

(10) Other functions as required to maintain "control" of the material.

d. I/O:

The I/O of the system will require a detailed analysis which will be prepared at the time of preparing the system specification. The general I/O interfaces are shown in Figure IV-G1.

e. Hardware

The hardware will be a third-generation computer with several remote keyboard (teletype) terminals, possibly some with CRT display, located throughout a shipyard in quantities suited to the needs of the working environment and the structure of the organization.

f. Software

The software will include a data management system by which any group of data may be related to any other is required. This could be an existing system in a shipyard computer complex or one available to an organization via leased terminals.

g. Data Base Support

The Master Catalog File is the significant development for this subsystem. It comprises all of the catalog data described in Section V of this report.

h. Mandatory Prerequisite or Parallel Development

Catalog file (Parts Catalog). This file will require the identification of components with a unique parts number for each unique item. A unique item would be related to differences in size, material, dimensions, manufacturer, etc. All attributes defining the components would be contained in the file. All transactions

(e.g., estimates, ordering, status etc.) would only require referral to the unique part number for identification and execution of the function. This concept would prove to be of significant benefit in data interchange between lead and follow yards.

i.   Phases of Developement

      I – Stand-alone subsystem in the design environment. Generate reports for the
           interfaces shown in Figure IV-G1.

      II – Develop and implement processor interfaces with planning, production,
           supply and others.

j.   Major Considerations

      (1) Development of a master catalog file that will be utilized by all shipbuild-
ers. A consideration must be made by the Navy shipbuilding community to utilize a
common master catalog file whether implementing the system on a computer-based en-
vironment or continuing in a semi-manual mode. This addressed the lead/follow situ-
ations in ship procurement.

      (2) Maintenance of the master catalog file, perhaps at a central site.

      (3) The system is dependent on a data management system. For best results, this
would be one that could be accessed by all shipyards and design agents.

k.   Method of Development

      The development of this system should involve:

      (1) A definition of the system and a study of the interfaces that must be made
with the existing systems (production control, MIS, etc.) in naval and private ship-
yards and by design agents. A plan to develop the system in several phases (at
least two are noted in paragraph (i) above) that will meet the needs of the users
and be cost-effective.

      (2) Development of the ELXDAC portion of the system by Navy contract.

      (3) Development of the interface with their own planning, MIS, supply, etc.,
systems by the users. The users could utilize the services of the Navy contractor
to develop their interfaces.

      (4) Extension of the system for other than electrical design.

2. ELXDAC STAND-ALONE SUBSYSTEM "M"

TITLE: Label Plates

a. Background

The ELXDAC system comprises 10 stand-alone subsystems. Subsystem "M," "Label Plates," is one of these systems. It shall also include the preparation of information plates. Although there may be some requirements in the Label Plates subsystem which are unique to the ELXDAC system, the requirements of this subsystem are basically common to the CAPDAC, HULDAC, CAMDAC and HVAC systems. In order to avoid duplication of effort, the development of the Label Plates subsystem will be a joint effort by the CASDAC systems.

Definition of Label Plate: A plate installed by a contractor which designates the component as part of a shipboard system, designates basic location number of component, or provides other necessary identification or information in addition to that appearing on identification plates or information plates.

Definition of Information Plate: A plate installed by a manufacturer or contractor that bears essential warning and operating and maintenance instructions.

b. Objective

The objective of the development of this subsystem is to permit a user (engineer, designer, shop man) to prepare a label plate list and drawing with a minimum of effort on his part. The system will format film negatives to manufacture label plates and provide installation schedules.

c. Description of System

The general description of the label plate system is shown in a flow chart, Figure IV-M1.

Input

● Electrical/electronic elementary, isometric, and schematic drawings

● Electrical arrangement drawings

● C & A drawings

Transform

● The user will assemble the following for the electrical system for which label plates are to be prepared:

●● electrical diagram

●● electrical arrangement drawings

23

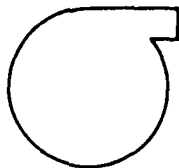Figure IV-M1
Sheet 1 of 5

SYMBOLS:

START OR COMPLETION OF A SERIES OF RELATED TASKS

OFF PAGE CONNECTORS· AA ARE TWO ALPHABETIC
CHARACTERS COMMON TO THE CONNECTION

HARD COPY DOCUMENTS-LISTS, REPORTS, DRAWINGS, ETC.

DATA FILES ON MAGNETIC MEDIA-TAPE OR DISK

COMPUTER SOFTWARE

TASKS-AS SPECIFIED WITHIN THE BLOCK

DECISIONS-AS SPECIFIED WITHIN THE BLOCK
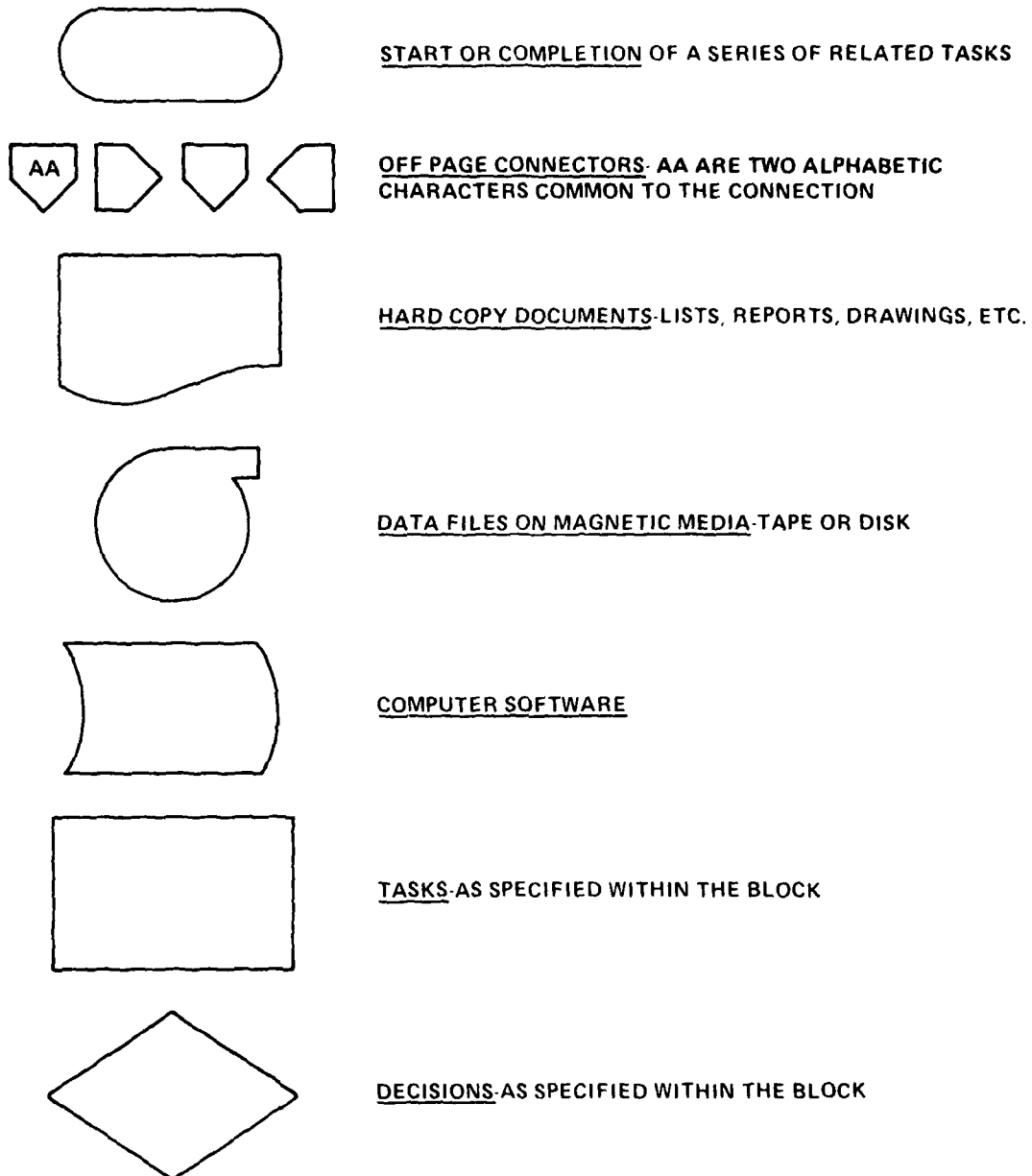
Figure IV-M1   ELXDAC Stand—Alone Subsystem "M" Label Plates
Flow Chart

24

Figure IV-M1
Sheet 2 of 5

START

E

SELECT
ELEC/ELEX
SYSTEM

SYSTEM DIAG
AND ARRGT DWGS
-C & A DWGS

COLLECT &
ORGANIZE DATA
REQ'D FOR
LABEL PLATE
PREPARATION

OPERATIONS
DATA

DRAWING
SCHEDULE

SELECT LABEL
PLATE DWG TITLE
& NUMBER
-IDENTIFY
CONPONENTS REQ
LABEL PLATES,
METHODS OF
ATTACHMENT
& LOCATION

SYSTEM
LABEL
PLATE
FILE

DATA
MGT
APPL
SOFTWARE

SYSTEM
NAME

DETERMINE
DESIGN
CRITERIA

GUIDELINES FOR
SYS & PERMISSABLE
LABEL PLATE
CONFIGURATIONS

MASTER
LABEL
PLATE
FILE

DATA
MGT
APPL
SOFTWARE

UPDATE
DESIGN

SHIP
SPECS

A

Figure IV-M1
Sheet 3 of 5

Figure IV-M1
Sheet 4 of 5
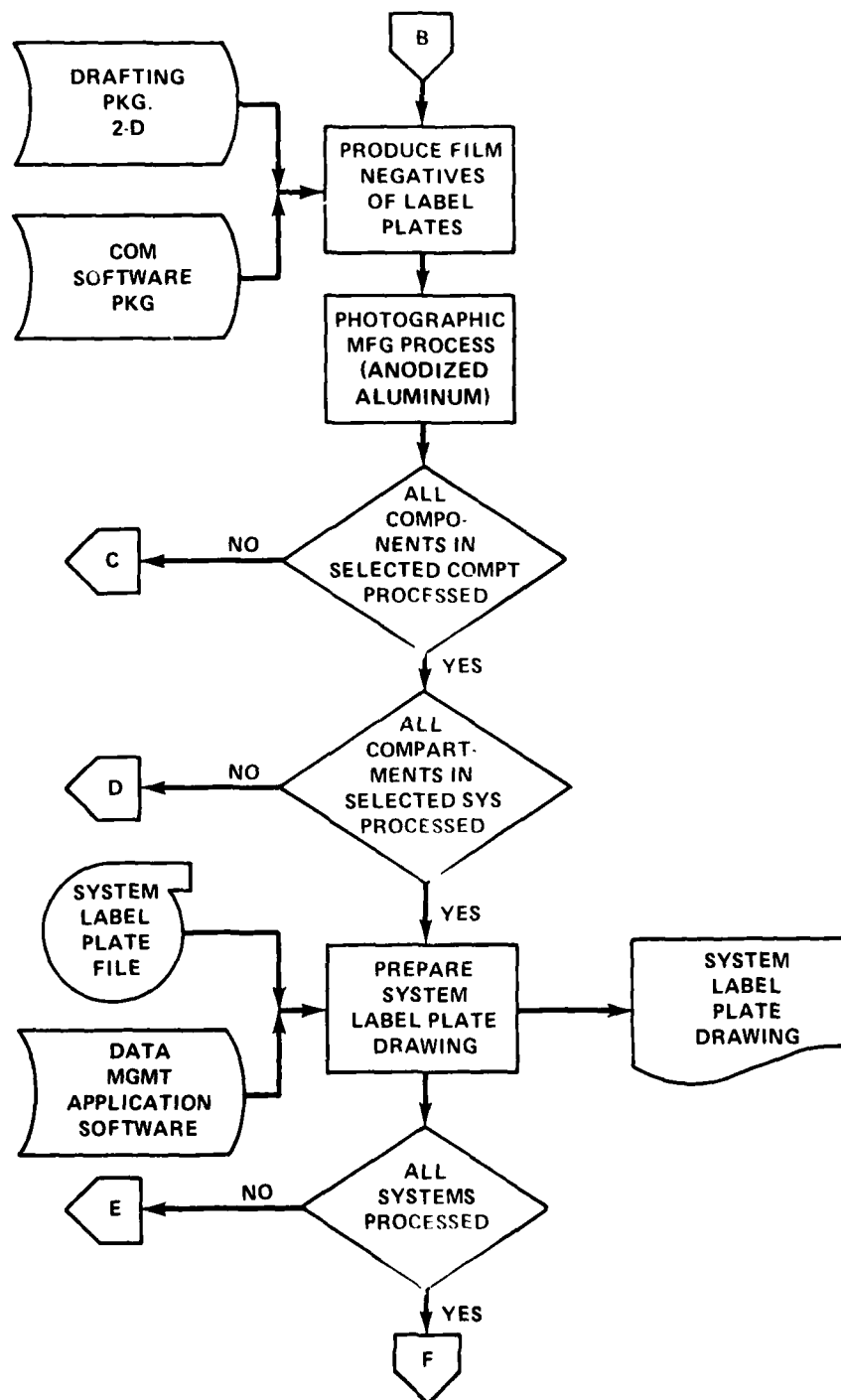
Figure IV-M1
Sheet 5 of 5
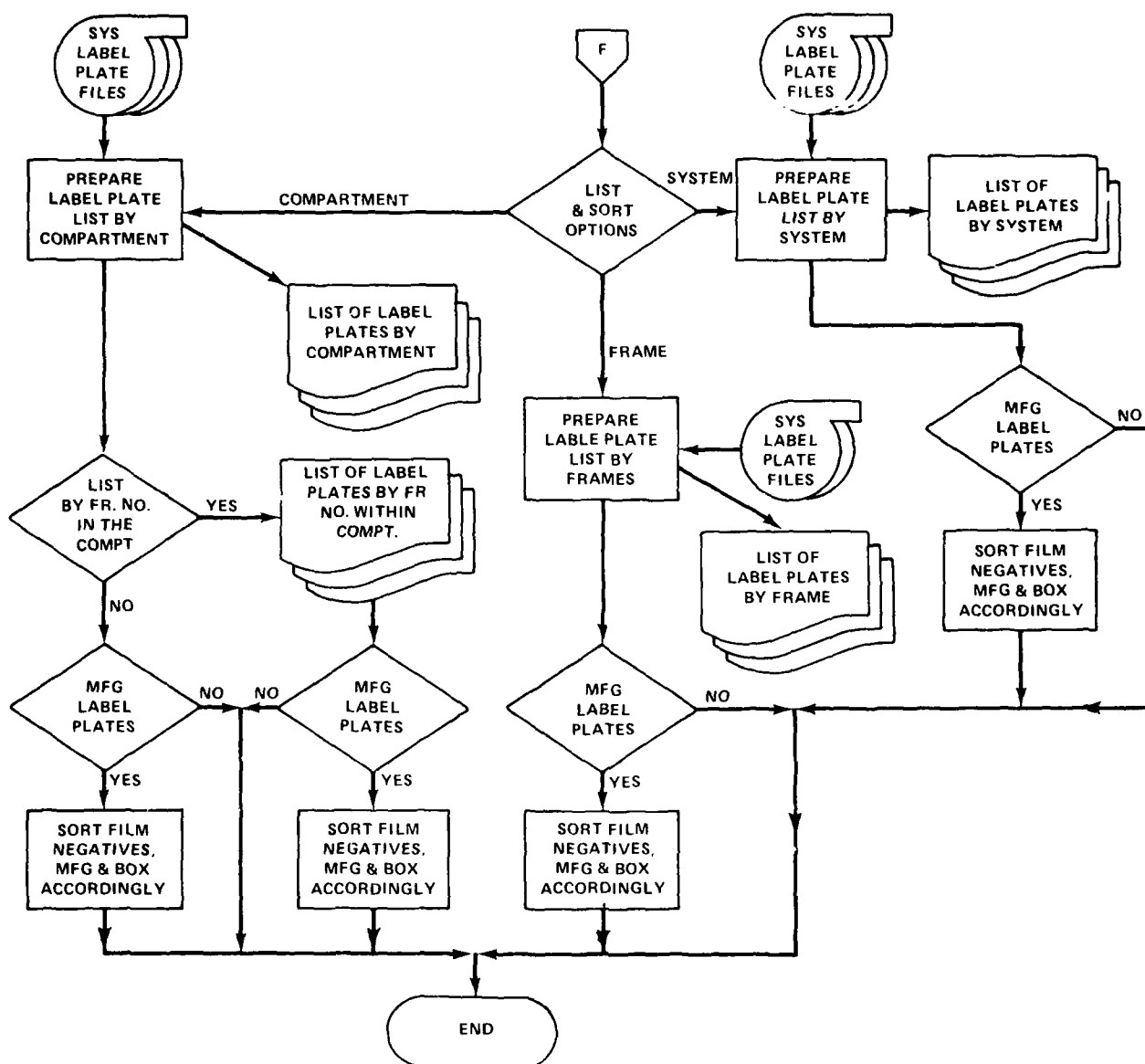
••   applicable C & A drawings

••   operating data

• The user will select the title and drawing number for the label plate draw-
ing from the drawing schedule. He will identify the components that
require label plates, determine the method by which each is attached and
the specific location of each component.

• The user will key into the interactive graphic terminal the name of the
electrical system and the name and number of the compartment or compart
ments in which the electrical system is housed.

• The computer system will display on the scope the various guidelines and
rules to be followed in preparing the label plates for the specified system
and any special rules related to the particular compartment. The display
shall indicate and illustrate the size, shape, thickness, and type number
of letter of all of the plates available for use with that system. Also
the type and size of letters and any color code requirements for a specific
system shall be displayed. Options shall also be displayed.

• Based on the particular system, the user will edit and delete data that
will not be of current use and input additional data to meet specific
requirements for that system. These may come from the ship specifications
to meet unique requirements. The final display, as edited, is subject to
recall at any time. This may be a multiple display. In that case the user
will be able to involve a scroll capability to search for data. Capability
shall exist for a full-scale display of the label plates.

• Using the electrical/electronic drawings, arrangement, and C & A drawing
as reference, the user will select and input a compartment identification.
He will input a component identification (such as TB-103), deck location
(04), frame location (78), and whether location is on centerline, star-
board, or port.

• The user will accept or edit the inscription with a light pen as required.
He will indicate type of attachment.

• The procedure will continue for the remaining components in the system.
Changes in compartments shall be inputted to the system.

• A similar plate display and text display capability shall be used in pre-
paring information plates.

Output

• A list of label plates for each specific electrical system. Each label
plate will be a line item and have a unique piece number for that ship.
Data typically included for each line item include:

●● Label plate standard, material, thickness, OD-ID, or width

●● Letter type and size

●● Quantity

●● Inscription

●● Method of attachment identification

●● Arrangement drawing number, electrical component identification number, location (deck, frame, centerline, port, or starboard)

●● Compartment

●● Revision letter

● A list of label plates for all systems in a compartment. The information for each system as listed above shall be included with the following addition for each line item.

●● System name

●● Label plate drawing number

● A format for each label plate for reproduction by photo chemical processing. Each label plate will bear the unique piece number.

● Installation schedule

A technique shall be developed so that the final production run of the fabricated plates can be sorted and packed to meet the optimal needs of the user:

●● All label plates in a compartment

●● All label plates in a system

●● All label plates by frame number

●● All label plates in a compartment and by frame number

A label plate listing shall be packed in each box of label plates indicating installation procedures.

● A similar output and computer listing for all information plates associated with each electrical system shall also be prepared.

d. Hardware

The generalized hardware requirements for this subsystem are shown in Figure IV-M2. Typically this would include:
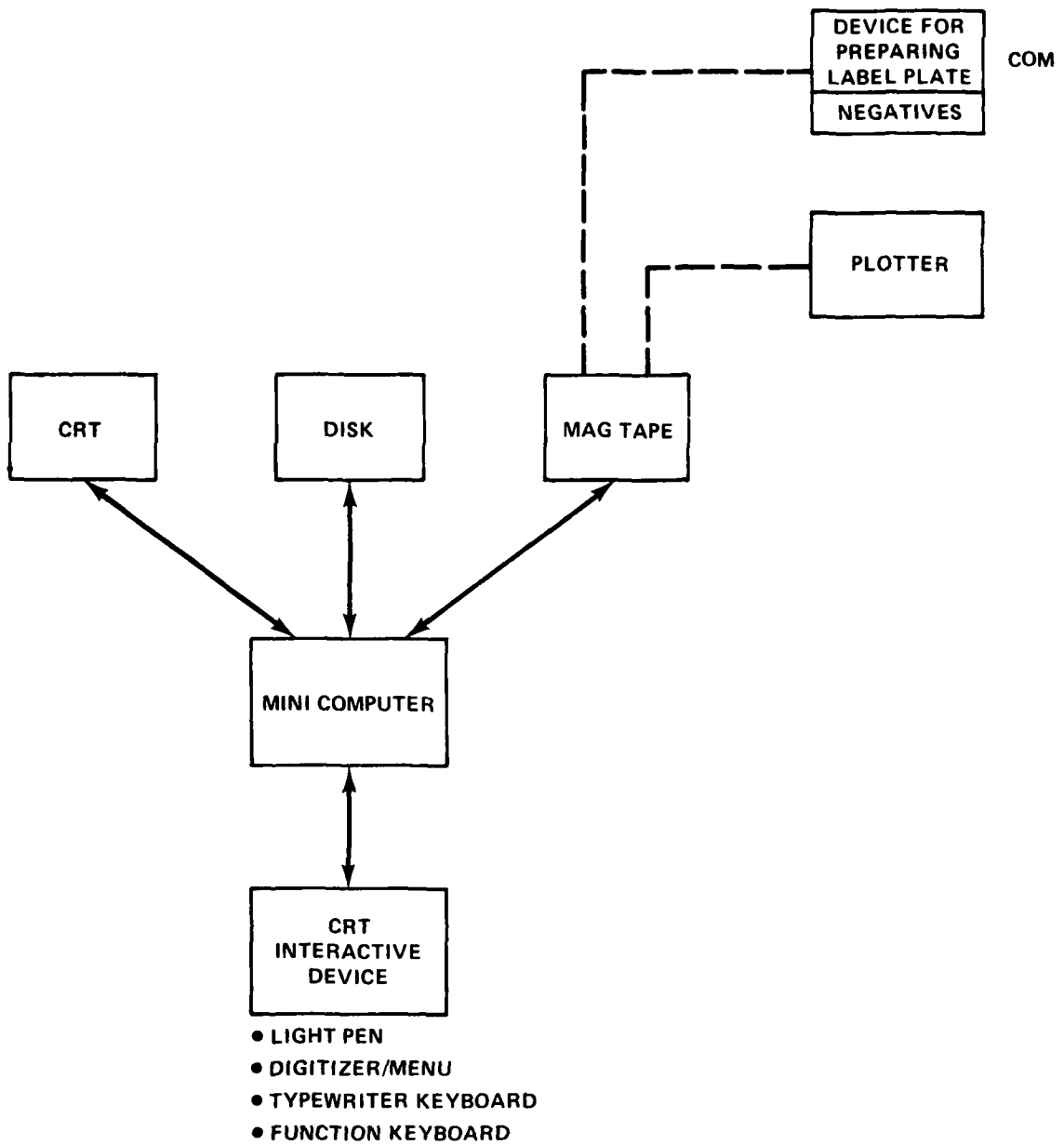
Figure IV-M2   Typical Hardware Configuration for Label Plate
Subsystem

31

- Minicomputer

- Disk storage

- Magnetic tape drive

- A CRT interactive terminal fitted with devices such as:

  - light pen

  - digitizer/menu

  - typewriter keyboard

  - function keyboard

- COM (computer output microfilm)

- Plotter

e. Software

The computer based environment for the stand-alone ELXDAC subsystem is described in Section III.

The software for this subsystem would include a requirement for a text-editing system suited for creating label plates and information plates. It should have the capability of editing text of mixed sizes and in circular format (semicircular label plates or rotary switches).

f. Data Base Support

The data base support is described in Section V of the Engineering Analysis. The data base ultimately required for this subsystem is:

- ELXDAC Support Software Numbers

  1, 2, 3, 4, 15, 17, 22, 23, 26, 27, 28

- Catalog and Technical Information Numbers

  C-4, C-13, C-14, C-15, C-18

In addition the following library should be included for each ship or ship class:

- List of electrical diagrams by system, number and title

- List of arrangement drawings by system, number and title

- List of compartments by numbering title and any special description affecting labeling

3. ELXDAC STAND-ALONE SUBSYSTEM "N"

TITLE: Test Procedures

a. Background

The ELXDAC system comprises 10 stand-alone subsystems. Subsystem "N," "Test Procedures," is one of these systems. Although there may be some requirements in the Test Procedures Subsystem which are unique to the ELXDAC system, the requirements of this subsystem are basically common to the CAPDAC, HULDAC, CAMDAC and HVAC systems. In order to avoid duplication of effort the development of the Test Procedures subsystem will be a joint effort by the CASDAC systems.

Shipboard test procedures contain much repetitive text information that is used on one ship after another. Existing procedures are generally reviewed and edited to meet new requirements and reissued as a new procedure for the particular ship.

b. Objective

The objective of the development of this subsystem is to permit a user (engineer, designer) to prepare a ship test procedure for a particular electrical/electronic system with minimal inputs.

The system shall also allow the user to prepare a list of tests for all electrical/electronic systems on a ship and/or class of ships.

c. Description of System

The general description of the test procedure system is shown in a flow chart, Figure IV-N1.

Input

● Name of electrical/electronic system

● Class or type of ship

Transform

● The user will key in the name of the electrical/electronic system and the class of ship that is the same as or similar to the one he is working on or other key words which will activate the files.

● The computer system will display a list of titles of the test procedure for review.

● The user will select a title for review and the procedure will be displayed or scrolled for review.

Figure IV-N1
Sheet 1 of 3

SYMBOLS:

START OR COMPLETION OF A SERIES OF RELATED TASKS

OFF PAGE CONNECTORS- AA ARE TWO ALPHABETIC
CHARACTERS COMMON TO THE CONNECTION

HARD COPY DOCUMENTS-LISTS, REPORTS, DRAWINGS, ETC.

DATA FILES ON MAGNETIC MEDIA-TAPE OR DISK

COMPUTER SOFTWARE

TASKS-AS SPECIFIED WITHIN THE BLOCK

DECISIONS-AS SPECIFIED WITHIN THE BLOCK
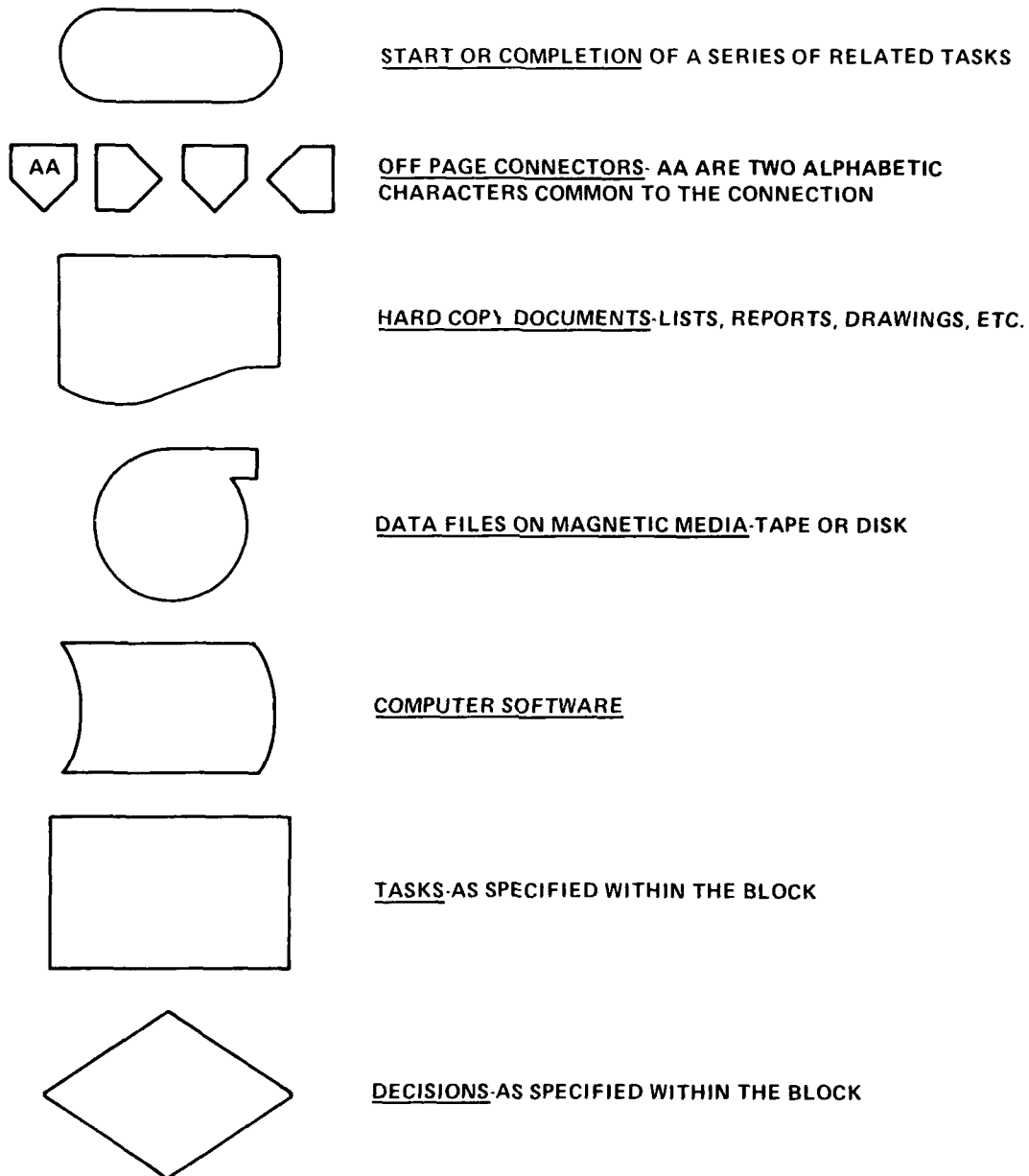
Figure IV-N1   ELXDAC Stand-Alone Subsystem "N" Test Specifications
                Flow Chart

Figure IV-N1
Sheet 2 of 3

Figure IV-N1

Figure IV-N1
Sheet 3 of 3

A

FILES-
SYSTEM
TEST PROCS
& PROCESS
INSTR

FILE-
LIST OF
ELEC/ELEX
PROCS

DATA
MANAGEMENT
APPLICATION
SOFTWARE

EXTRACT
PERTINENT DATA
FROM EACH FILE
TO PREPARE
LIST OF ELEC/ELEX
PROCS FILE

HARD COPY
OF FILE

STOP
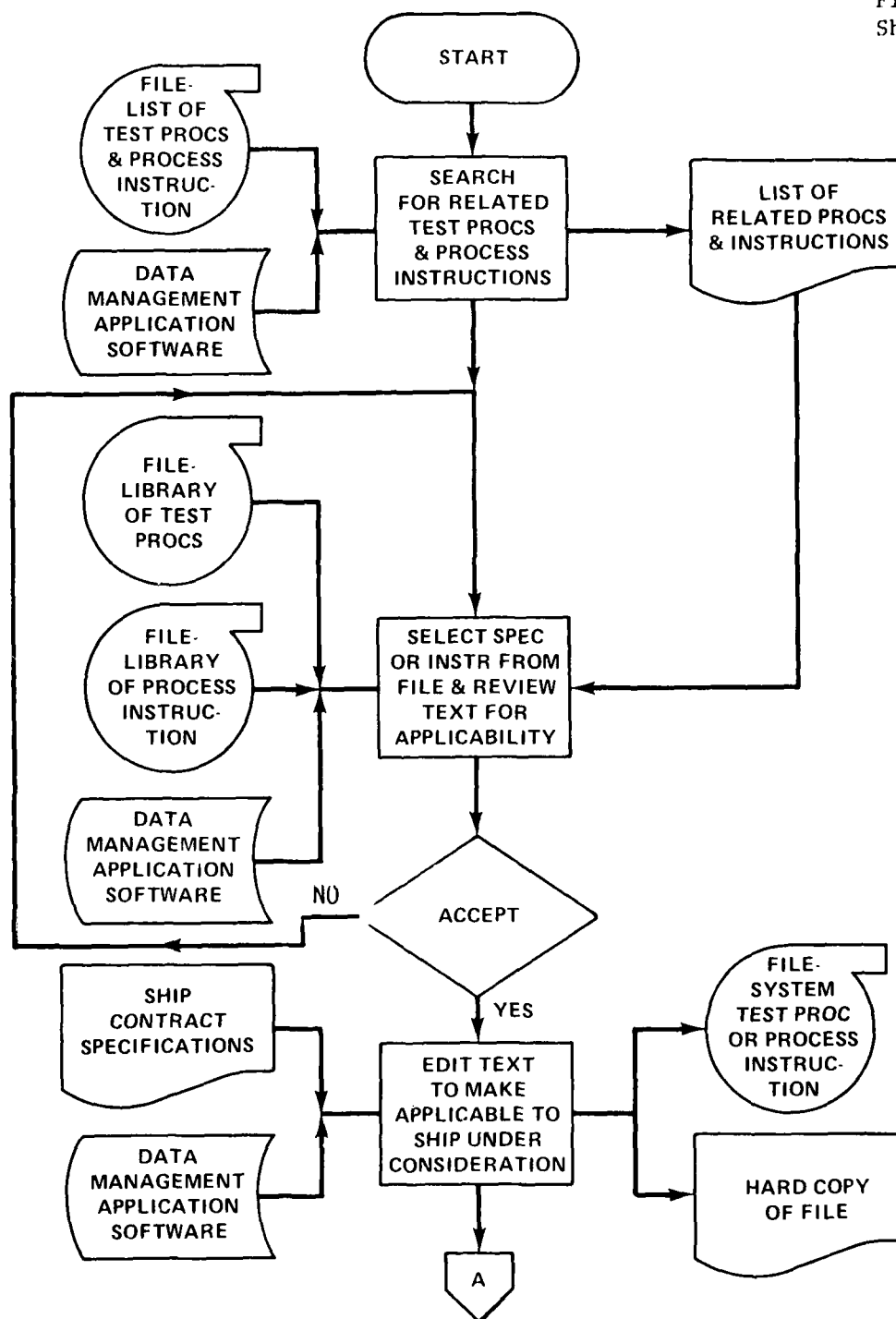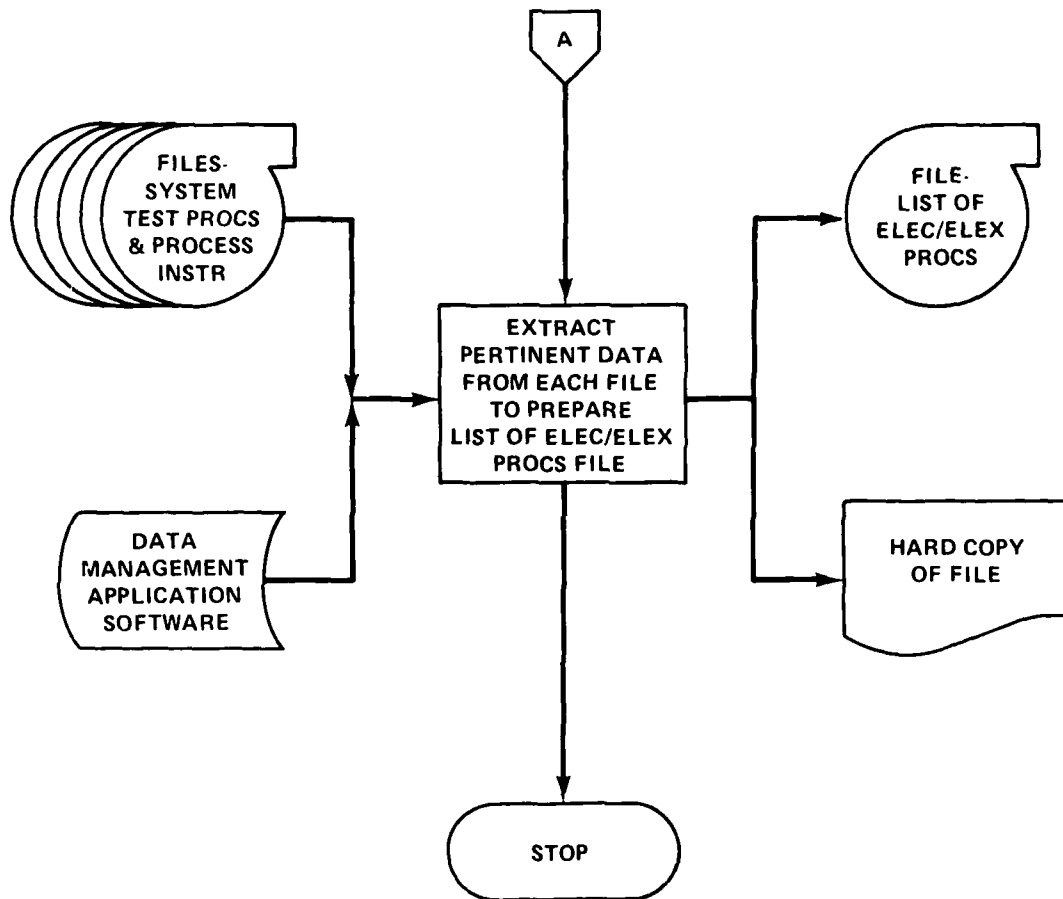
● If the user determines that the library-formatted procedure is basically
suited to the new requirements, it is printed. If not, all necessary
editing is accomplished by use of an interactive mode with a CRT.

● The user specifies distribution of the procedure.

● The user(s) repeats this procedure for all electrical/electronic systems.

● After preparation of all electrical/electronic system test procedures for
a particular ship, a drawing "list of electrical/electronic tests" is pre-
pared for the ship.

Output

● A master copy of a electrical/electronic system test procedure.

● A list of tests for a ship's electrical/electronic system.

d.   Hardware

The generalized hardware requirements for this subsystem is shown in Figure
IV-N2. Typically this would include:

● Computer

● Disk storage for catalogs

● CRT display with cursor device for editing. Hard copy capability desirable.

● High speed printer for preparation of text.

● Pen-type plotter for preparation of sketches and drawings that accompany
test procedures or an electrostatic printer/plotter that would also provide
above high-speed printer functions.

NOTE: This is an option for simple modifications to existing diagrams and sketches.
Utilize subsystem "D" Drawing and Material Lists for the preparation of new
drawings to accompany test specifications.

e.   Software

The computer-based environment for the stand-alone ELXDAC subsystem is des-
cribed in Section III.

The software for this subsystem would include a requirement for a text-editing
system suited for creating test procedures.

f.   Data Base Support

The data base support is described in Section V of the Engineering Analysis.
The data base ultimately required for this subsystem is:

DISK

PRINTER

ELECTROSTATIC
PRINTER/
PLOTTER

OR

PLOTTER

COMPUTER

CRT TERMINALS WITH HARD COPY CAPABILITY
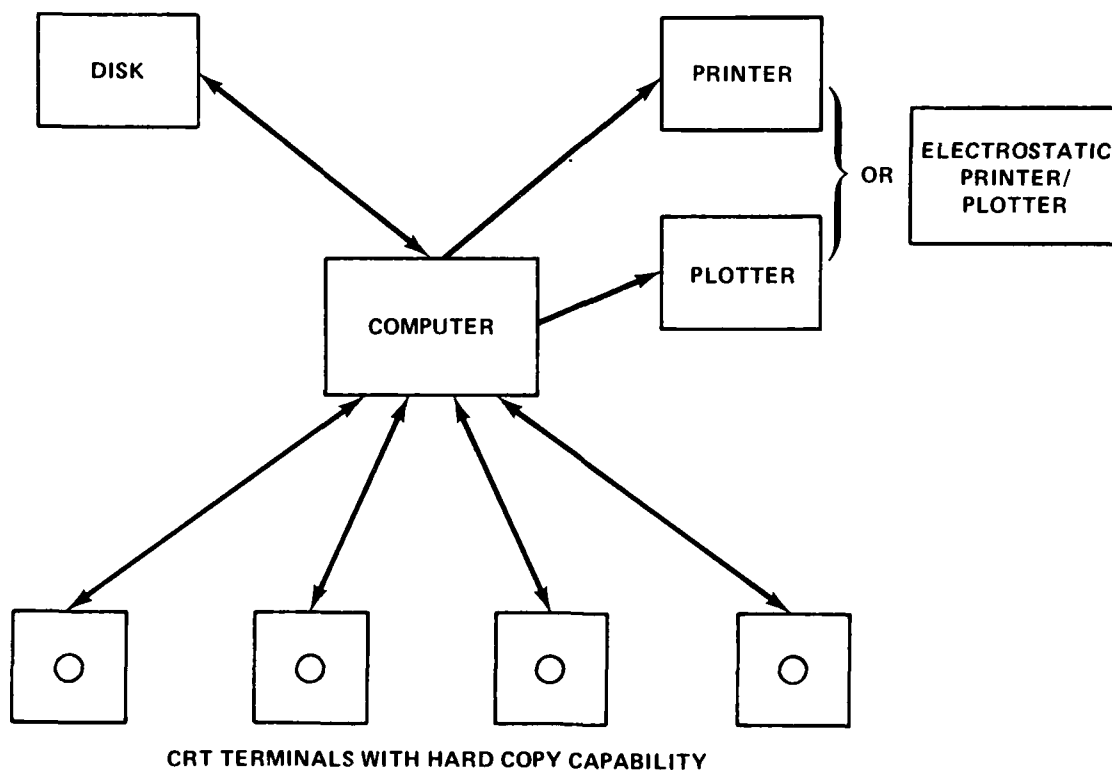
Figure IV-N2   Typical Hardware Configuration for Test Specification
Subsystem

38

ELXDAC Support Software Numbers

1, 2, 3, 4, 5, 6, 10, 11, 13, 15, 19, 21, 26, 29

Catalog and Technical Information Numbers

C4, C7, C10, C17, C19, C20

g. References

(1) General Specifications for Ships of the U.S. Navy, NAVSHIPS 0902-001-5000

● Section 092 Shipboard Tests

● Section 400 General Requirements for Electronic Systems

● Section 404 Radio Transmission Lines

(2) NAVSEA Code 06C2 Test and Evaluation System

h. Guidance

Review the requirements of references (1) and (2) and the practices of a selected shipyard to be specified later.

The general intent is to develop a demonstratable capability based on the electrical/electronic systems for one ship using the formats of a selected shipyard.

Each user shipyard can either adapt and build on the developed capability or develop catalog files suited to his individual needs.

4. ELXDAC STAND-ALONE SUBSYSTEM "F"

TITLE: Arrangement Drawings

a. Background

The ELXDAC system comprises 10 stand-alone subsystems. Subsystem "F," "Arrangement Drawings," is one of these systems. Although there may be some requirements in the Arrangement Drawings subsystem which are unique to the ELXDAC system, the requirements of this subsystem are basically common to the CAPDAC, HULDAC, CAMDAC, and HVAC systems. In order to avoid duplication of effort the development of the Arrangement Drawings subsystem will be a joint effort by the CASDAC systems.

The arrangement drawings shall be those of spaces housing electrical/electronic systems.

Figure IV-F1 is a flow chart of the stand-alone arrangement drawings subsystem.

b. Objective

The objective of this development is to permit a user (engineer or designer) to prepare an electrical or electronic arrangement drawing in a computer-based environment with a minimum of effort on his part in detailed drafting procedures. He will derive from electrical/electronic system drawings, standard plans, and technical manuals the necessary plan, elevation, section, and partial views that are required to meet the planning and production requirements. By automated procedures the user will add the necessary dimensions, labels, notes, title block references, etc., to complete an arrangement drawing. Associated lists of material are to be prepared.

c. Description of System

The general description of the arrangement drawing system is shown in a flow chart, Figure IV-F1. The layout of the flow chart shows:

Input

- Contract guidance arrangement plans

- Electrical/electronic system drawings

- Electrical/electronic equipment dimensions and required clearances

- Drawings of C & A, structure, ventilation drawings, electrical wireways, arrangement drawings of other systems

- Material catalog data

Transform

The following description is an overview of the process shown in Figure IV-F1.

40

Figure IV-F1
Sheet 1 of 6

SYMBOLS:

START OR COMPLETION OF A SERIES OF RELATED TASKS

OFF PAGE CONNECTORS- AA ARE TWO ALPHABETIC
CHARACTERS COMMON TO THE CONNECTION

HARD COPY DOCUMENTS-LISTS, REPORTS, DRAWINGS, ETC.

DATA FILES ON MAGNETIC MEDIA-TAPE OR DISK

COMPUTER SOFTWARE

TASKS-AS SPECIFIED WITHIN THE BLOCK

DECISIONS-AS SPECIFIED WITHIN THE BLOCK

Figure IV-F1   ELXDAC Stand-Alone Subsystem "F" Arrangement Drawings
Flow Chart.

Figure IV-F1
Sheet 2 of 6

START

LIST OF ARRGT DWGS (SCHEDULE)

SELECT THE ARRANGEMENT DRAWING TO BE DEVELOPED

SYSTEM DRAWINGS

OBTAIN THE APPLICABLE ELECTRICAL/ ELECTRONIC SYSTEM DRAWINGS

IS A COMPOSITE DRAWING AVAILABLE FOR THE ZONE

YES

NO

C & A DWGS· MACHY AND/ OR OTHER ARRGT DWGS

MAJOR & DETAIL STRUCTURAL DWGS

VENTILATION DWGS· ELECTRICAL WIREWAY DWGS

OTHER DATA RELATED TO ZONE

MANUALLY PREPARE A PRELIMINARY ARRGT DWG THIS DWG SHOWS THE MAJOR ELEC/ELEX COMPONENTS (PLAN, SECTION & ELEVATION) AS THEY WOULD APPEAR ON A COMPOSITE DWG

PRELIM ARRGT DWG

AA   TO SHEET 3

Figure IV-Fl
Sheet 3 of 6

AA FROM SHEET 2

IS THE COMPOSITE DWG/ PRELIM ARRGT IN A 3-D DIGITAL FORM AS PREPARED BY THE ELXDAC "DWG" SUBSYSTEM "E"

YES

NO

COMPOSITE DWG OR PRELIM ARRGT

STRUCTURAL DRAWINGS, ETC.

TEMPLATE LIBRARY FOR EQUIP

MATERIAL CATALOG

GEO CHARAC- TERISTICS FILE

MENU TECHNIQUE AT DIGITIZER OR KEY PUNCH FORMATS

SPECIAL ARRGT DWG PKG

TEMPLATE GENERATION PROGRAM

DATA MGMT APPLICATION SOFTWARE

DIGITIZE THE LOCATIONS OF MAJOR COMPONENTS AND PUT THEM INTO A 3-D DIGITAL MODEL FORMAT-THIS TASK ALSO PROVIDES THE 2-D STRUCTURAL AND EQUIPMENT BACKGROUND

"QUICK LOOK" CRT

3-D DIGITAL MODEL OF ELEC/ELEX SPACE

COMBINED BACK- GROUND FILE

(STRUCTURE IN 2-D DIGITAL VIEWS)

BB TO SHEET 4

43

Figure IV-F1
Sheet 4 of 6

BB FROM SHEET 3

3-D DIGITAL MODEL OF SYS

COMBINED BACK-GROUND FILE

GEO CHARAC-TERISTICS FILE

3-D DRAFTING PKG

PRODUCE DWGS (PLAN, SECT & ELE'/) SHOWING THE PORTION OF THE ELEC/ELEX EQUIPMENT OF INTEREST INDEPENDENT OF OTHER SYSTEMS

"BARE BONES" DWGS OF SYSTEM

ELEC/ELEX SYSTEM DWG OR DIGITAL DATA AS PRODUCED BY ELXDAC SUBSYS "D"

MENU TECHNIQUE AT DIGITIZER OR KEY PUNCH FORMATS

MATERIAL CATALOG

GEO CHAR FILE

DATA MGMT APPLICATION SOFTWARE

USING THE DWGS ADD ADDT'L REQ'D COMPONENTS NOT INCLUDED ON COMPOSITE/PRELIM ARRGT DWG TO BRING DELINEATION OF THE SYSTEM TO THE LEVEL OF DETAIL REQUIRED FOR CONSTRUC-TION AND FIELD INSTALLATION ·RELATE ALL COMPONENTS (PREVIOUSLY IDENTIFIED AND NEWLY ADDED) TO CATALOG IDENT IN ACCORDANCE WITH THE DIAGRAMMATIC SCHEDULES AND LISTS

COMPLETE STRUCTURED DIGITAL DESCRIPTION OF ELEC/ELEX SYSTEM (3-D GRAPHICS WITH POINTERS, ETC)

CC TO SHEET 5

1/4

Figure IV-F1
Sheet 5 of 6

Figure IV-F1
Sheet 6 of 6

- The designer selects an arrangement drawing to be prepared from the drawing schedule.

- The designer develops a compartment outline based upon C & A drawings and structural drawings if a computer generated compartment outline is not available. The compartment outline is then displayed on a CRT.

- Any existing background arrangement data from electrical wireways, ventilation and piping is then displayed on the compartment outline.

- The designer then determines all the equipment that is required to be in the compartment. The computer-based system aids the designer in the compilation of this equipment.

- The designer then manipulates templates which are scaled dimensions of the equipment required to be housed in the compartment until a suitable arrangement is determined. Such items as access and clearance requirements have to be checked.

- A copy of the drawing is displayed on the CRT and the designer will assign equipment item numbers and labels. These labels and item numbers may be positioned by light pen or other device to improve legibility. The system keeps a record of the total item numbers and labels and prepares a draft of the drawing list of materials.

- After interaction with "material control" which will add source data, etc., a final list of material is prepared.

Output

- An arrangement drawing

- A list of material

d. Hardware

The generalized hardware requirements for this subsystem are shown in Figure IV-F2. Typically this would include:

- Minicomputer

- Disk storage

- CRT

- X - Y readout   Multiple units would be provided
                                         for additional drafting stations.
- Digitizer (keyboard and cursor)

- Off-line plotter

47
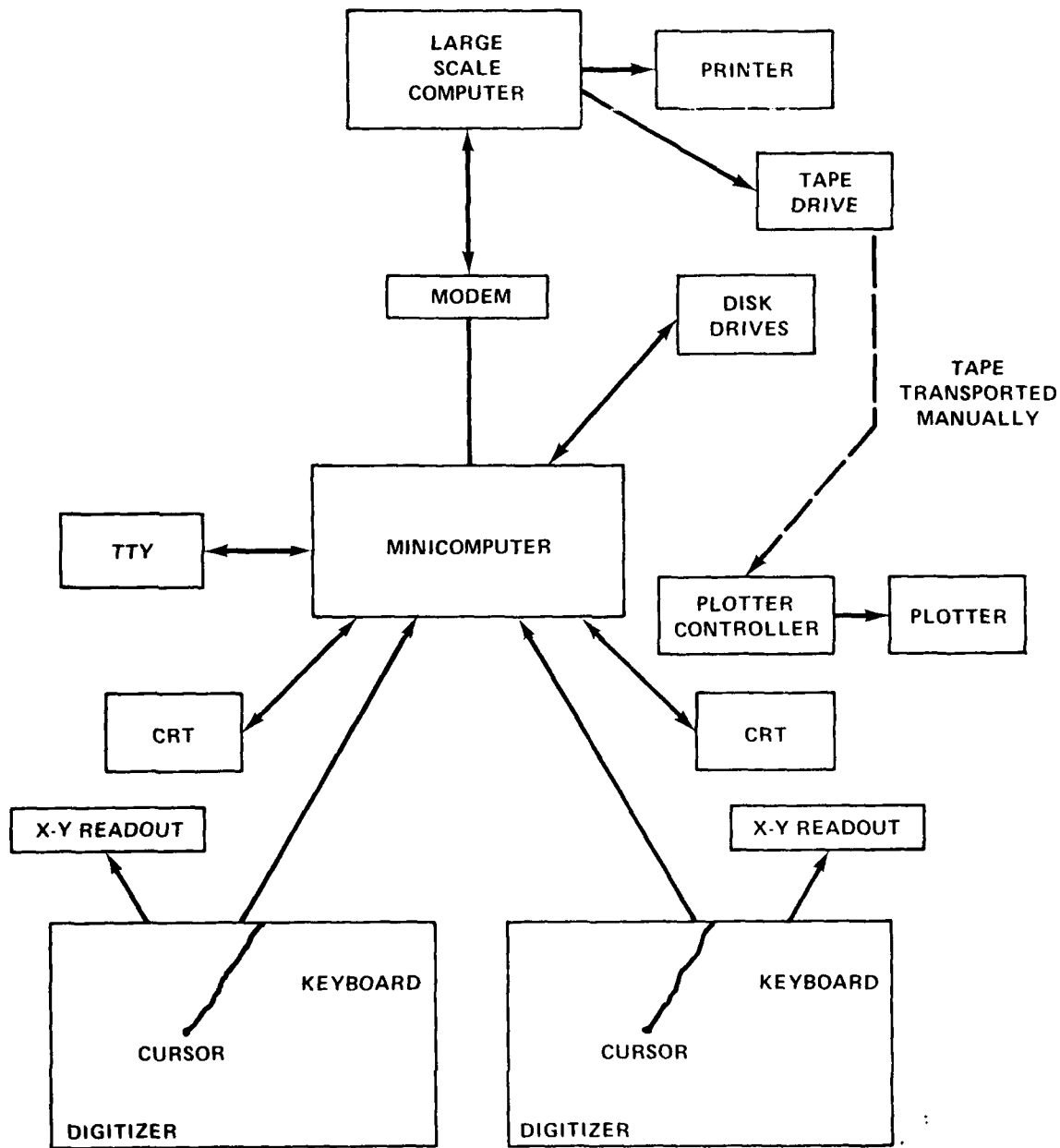
Figure IV-F2   Typical Graphic Data Reduction and Design Station—
                Two Digitizers

48

- Interface with large-scale computer

- Teletype

e. Software

The computer-based environment for the stand-alone ELXDAC subsystem is described in Section III. The software will include several analysis programs related to arrangements.

f. Data Base Support

The data base support is described in Section V of the Engineering Analysis. The data base ultimately required for this subsystem is:

- ELXDAC Support Software Numbers

  1, 2, 3, 4, 10, 11, 12, 14, 17, 18, 19, 21, 22, 23, 24, 25, 26, 27

- Catalog and Technical Information Numbers

  C-1, C-2, C-6, C-8, C-9, C-13, C-14, C-18, C-19, C-20, C-21, C-22

5.   ELXDAC STAND-ALONE SUBSYSTEM "C"

TITLE: Ship Specification

a.   Background

The ELXDAC system comprises 10 stand-alone subsystems. Subsystem "C," "Ship Specification," is one of these systems. Although there may be some requirements in the Ship Specification subsystem which are unique to the ELXDAC system, the requirements of this subsystem are basically common to the CAPDAC, HULDAC, CAMDAC, and HVAC systems. In order to avoid duplication of effort the development of the Ship Specification subsystem will be a joint effort by the CASDAC systems.

Many of the ship specification requirements that have an impact on electrical design are in sections of the specifications that are not readily identified as being applicable to electrical design. In some instances individual engineers and designers unknowingly violate or do not meet pertinent requirements because of oversights.

b.   Objectives

The objective of the development of this subsystem is to permit an electrical engineer or designer to quickly determine all of the design guidelines, constraints, and parameters for the design of a specific electrical or electronic system for a specific ship.

c.   Description of System

The general description of the Ship Specification System is shown in a flow chart, Figure IV-C1.

Input

Computer-based inputs

● Library of general specification requirements.

● Library of contract specification requirements.

Transform

● The user will select one of the electrical or electronic systems from the drawing schedule.

● A list of the 15 electrical and electronic systems as listed in Section VI of the Engineering Analysis will be displayed.

● For the selected system a display will show what sections of the General Specifications and what sections of the contract specifications contain requirements pertaining to that electrical or electronic system.

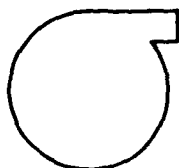Figure IV-C1
Sheet 1 of 3

SYMBOLS:

START OR COMPLETION OF A SERIES OF RELATED TASKS

AA

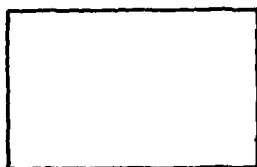OFF PAGE CONNECTORS- AA ARE TWO ALPHABETIC
CHARACTERS COMMON TO THE CONNECTION
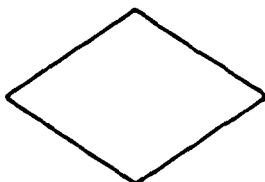
HARD COPY DOCUMENTS-LISTS, REPORTS, DRAWINGS, ETC.

DATA FILES ON MAGNETIC MEDIA-TAPE OR DISK
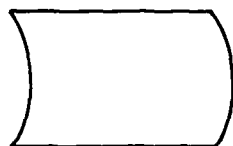
COMPUTER SOFTWARE
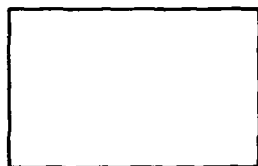
TASKS-AS SPECIFIED WITHIN THE BLOCK
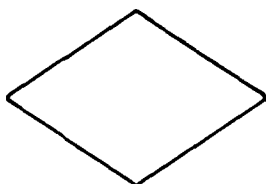
DECISIONS-AS SPECIFIED WITHIN THE BLOCK

Figure IV-C1   ELXDAC Stand-Alone Subsystem "C" Ship Specifications
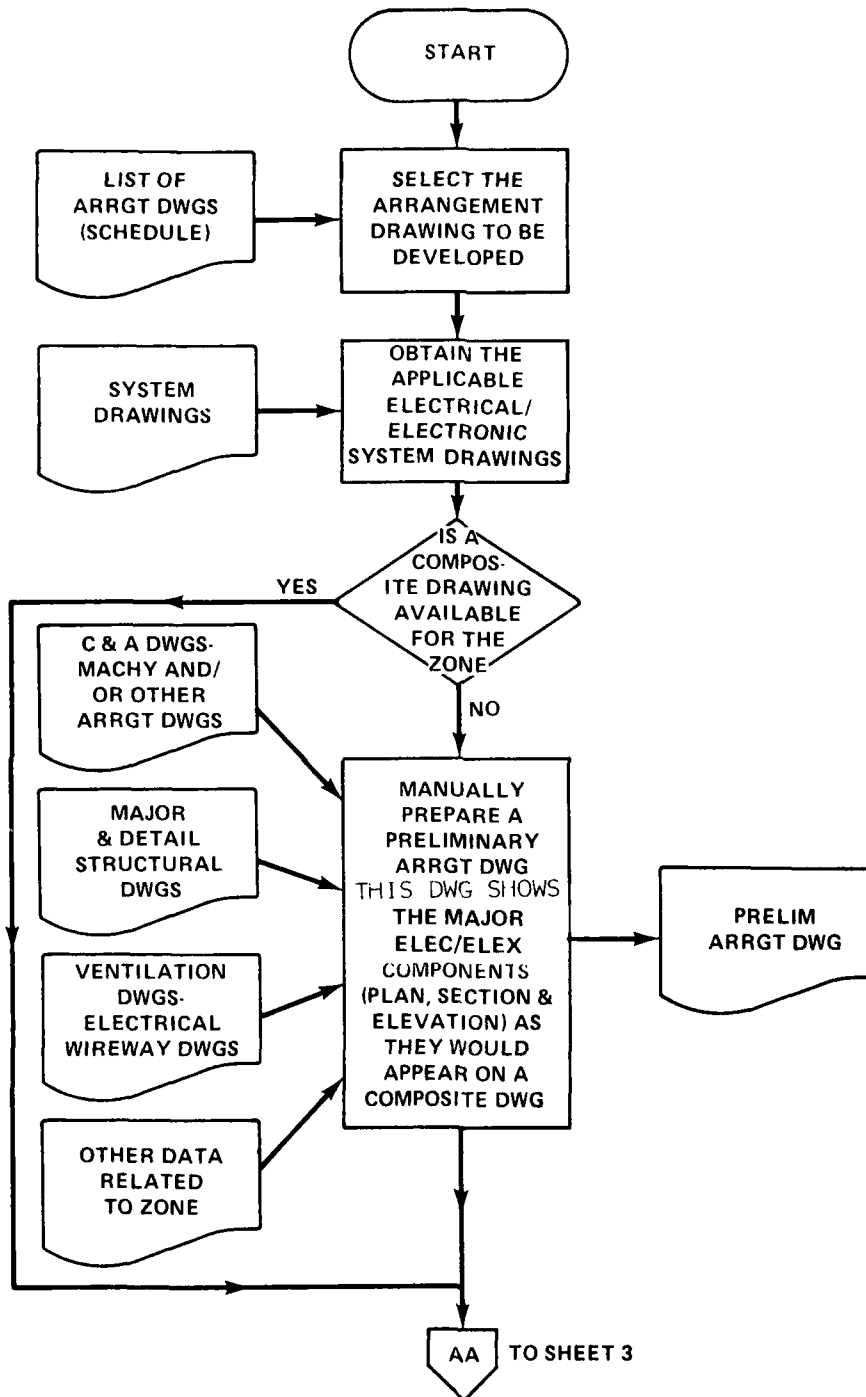Flow Chart

Figure IV-C1
Sheet 2 of 3
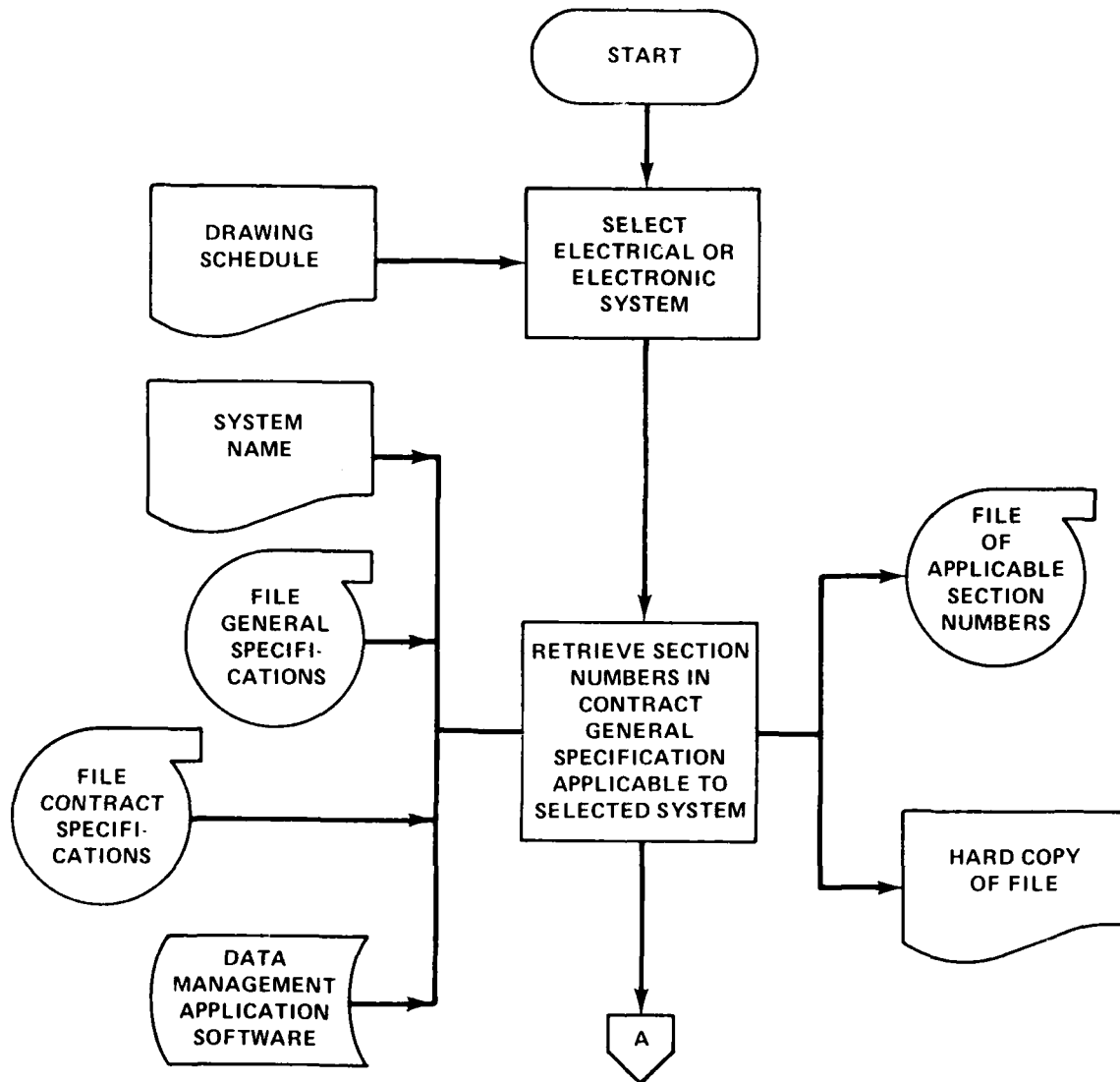
Figure IV-C1
Sheet 3 of 3

Figure IV-C1

53
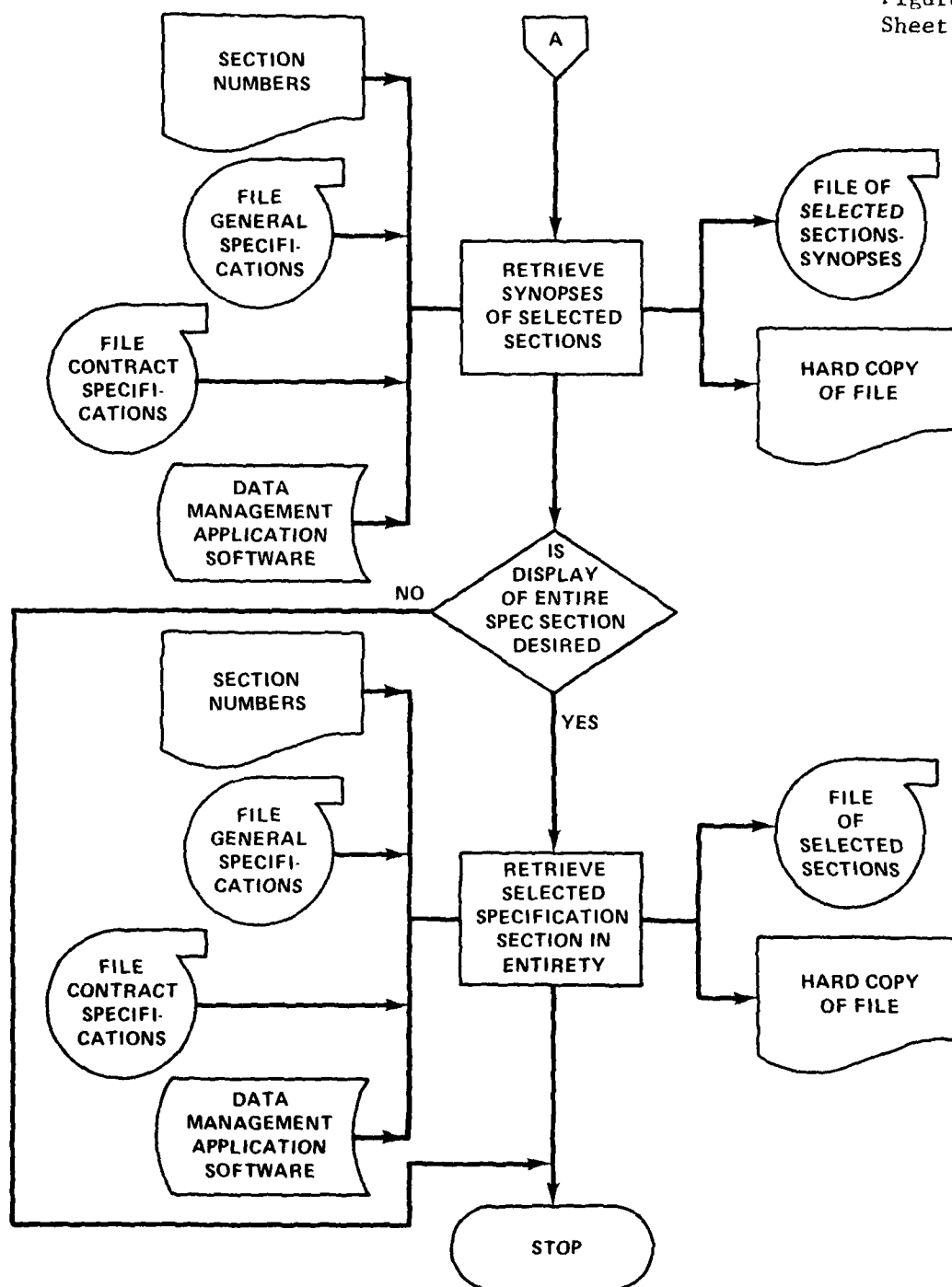
- The user will select those sections of either the General Specifications or the contract specifications, or both, that he is interested in. Those may be in the areas of structure, electrical/electronic, ventilation, piping, etc.

- A display will provide a brief synopsis of the requirements contained in each selected section.

- The user can then further select those sections for which he wants a complete display and a printout of the specification requirements.

Output

- The output should take the form of a hard copy at the terminal of any display.

- A complete listing of the general requirements for all electrical and electronic systems listed under applicable sections of the general specifications or the contract specifications.

- A complete listing of the requirements of a specific electrical or electronic system listed under applicable sections of the general specifications or the contract specifications. Excluded from this listing would be the general requirements for all electrical and electronic systems.

d. Hardware

The generalized hardware requirements for this subsystem are shown in Figure IV-C2. Typically this would include:

- Third-generation computer

- Disk storage for specification files

- CRT terminals with hard copy capability

- High-speed printer

e. Software

The computer-based environment for the stand-alone ELXDAC subsystem is described in Section III. The software for this system would include a requirement for a text-editing system suited for creating the electrical or electronic specifications.

f. Data Base Support

The data base support is described in Section V of the Engineering Analysis. The data base ultimately required for this subsystem is:
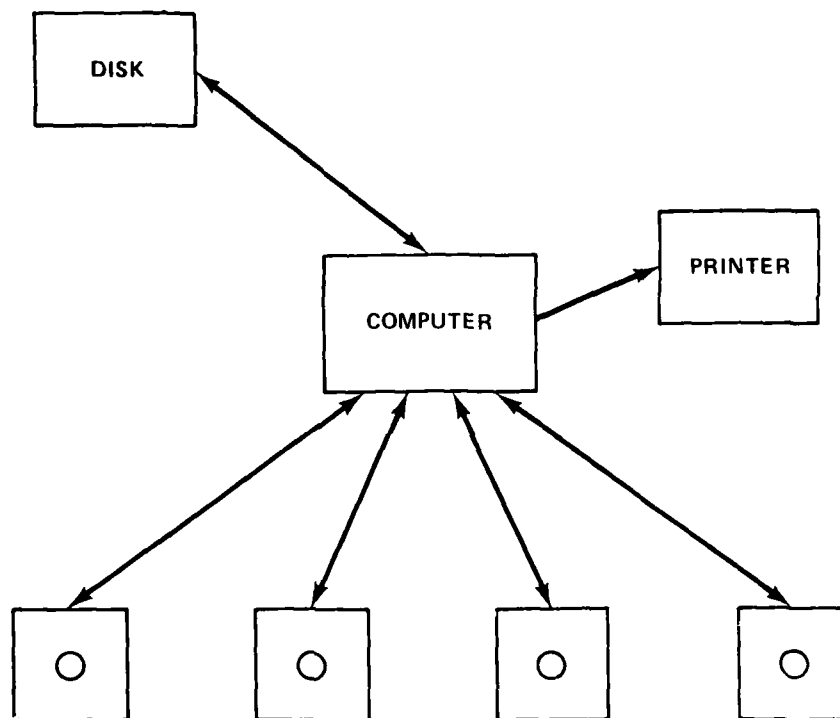
CRT TERMINALS WITH HARD COPY CAPABILITY

Figure IV-C2   Typical Hardware Configuration for Ship Specification
System

- ELXDAC Support Software Numbers

  1, 2, 3, 4, 26, 29

- Catalog and Technical Information Numbers

  C-4, C-5, C-10, C-11, C-12, C-13, C-14, C-15, C-16, C-17

- General Specifications Data Files – A compilation of all paragraphs in all sections of the general specifications that contain requirements related to any of the 15 electrical and electronic systems

- Contract Specification Data Files – For a selected ship, structure the data contained in the contract specifications in a manner similar to that for the General Specifications.

g. References

(1) General Specifications for Ships of the U.S. Navy, NAVSHIPS 0902-001-5000

h. Guidance

The Naval Sea Systems Command has developed a computerized capability to create contract specifications from the General Specifications, Reference (1). This work should be investigated for possible utilization in developing this ELXDAC subsystem.

6. ELXDAC STAND-ALONE SUBSYSTEM "A"

TITLE: Documentation

a. Background

The ELXDAC system comprises 10 stand-alone subsystems. Subsystem "A," "Documentation," is one of these systems.

The Documentation Subsystem will be used for the preparation of CFE procurement specifications and for ship operational instructions. Existing documentation is generally reviewed and edited to meet new requirements and reissued as a new document for the particular ship.

b. Objective

The objective of the development of this subsystem is to permit an electrical engineer or designer to prepare procurement and operational documentation for a particular ship.

c. Description of System

The general description of the documentation system is shown in a flow chart, Figure IV-A1.

Input (Procurement and Operational Documentation)

- Detail Specifications

- Contract Guidance Drawings

- GFE/GFI

- Equipment Lists

- Vendor Data

- Arrangements

- Drawings and List of Materials

- System Analysis and Calculations

- Preliminary Electrical/Electronic Studies

- Component Sizing

- Preliminary Equipment Selection and Long Lead Time List
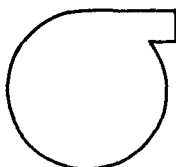
Figure IV-A1
Sheet 1 of 2

SYMBOLS:

START OR COMPLETION OF A SERIES OF RELATED TASKS

OFF PAGE CONNECTORS- AA ARE TWO ALPHABETIC
CHARACTERS COMMON TO THE CONNECTION

HARD COPY DOCUMENTS-LISTS, REPORTS, DRAWINGS, ETC.

DATA FILES ON MAGNETIC MEDIA-TAPE OR DISK

COMPUTER SOFTWARE

TASKS-AS SPECIFIED WITHIN THE BLOCK

DECISIONS-AS SPECIFIED WITHIN THE BLOCK
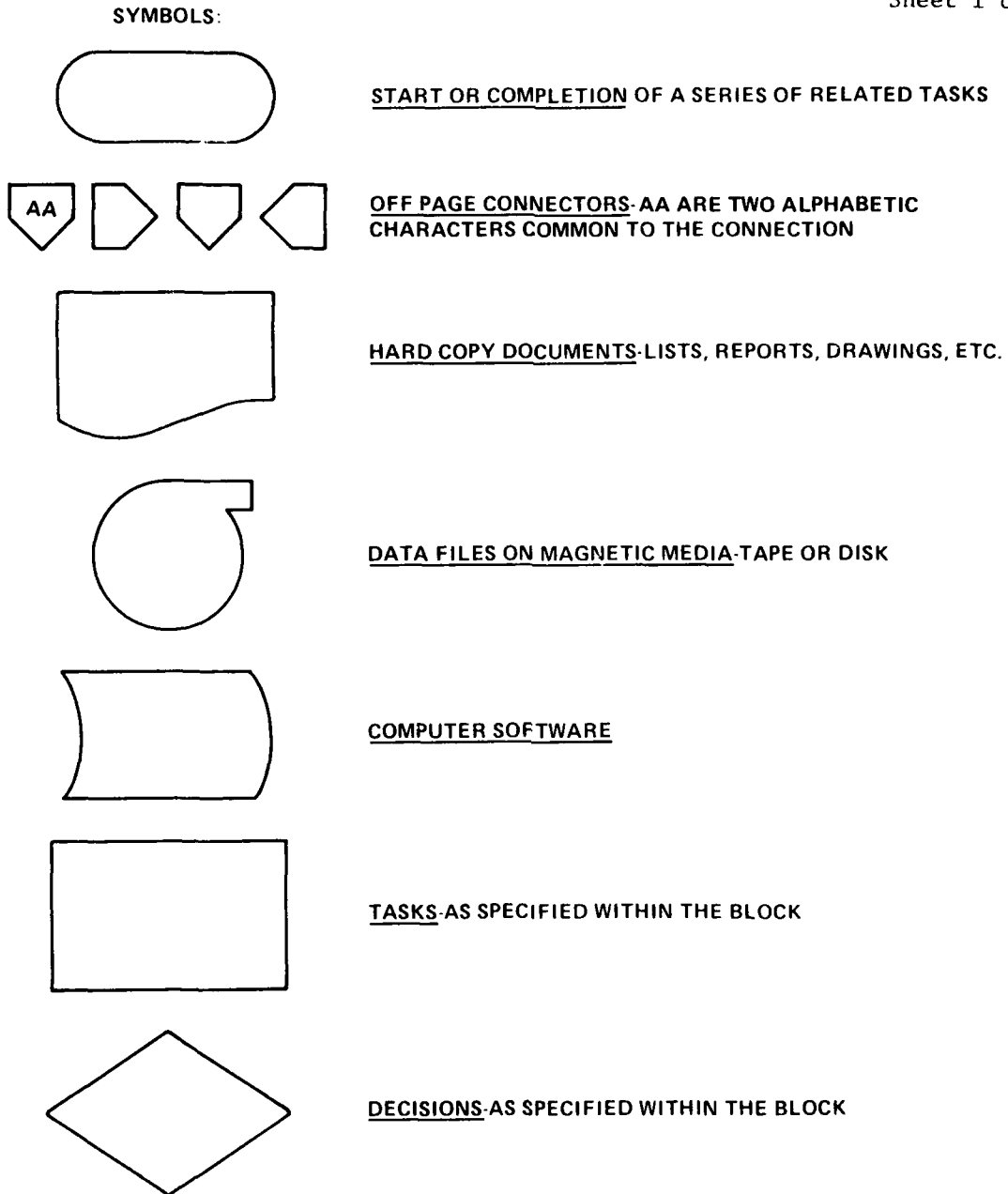
Figure IV-A1   ELXDAC Stand-Alone Subsystem "A" Documentation
Flow Chart

Figure IV-Al
Sheet 2 of 2
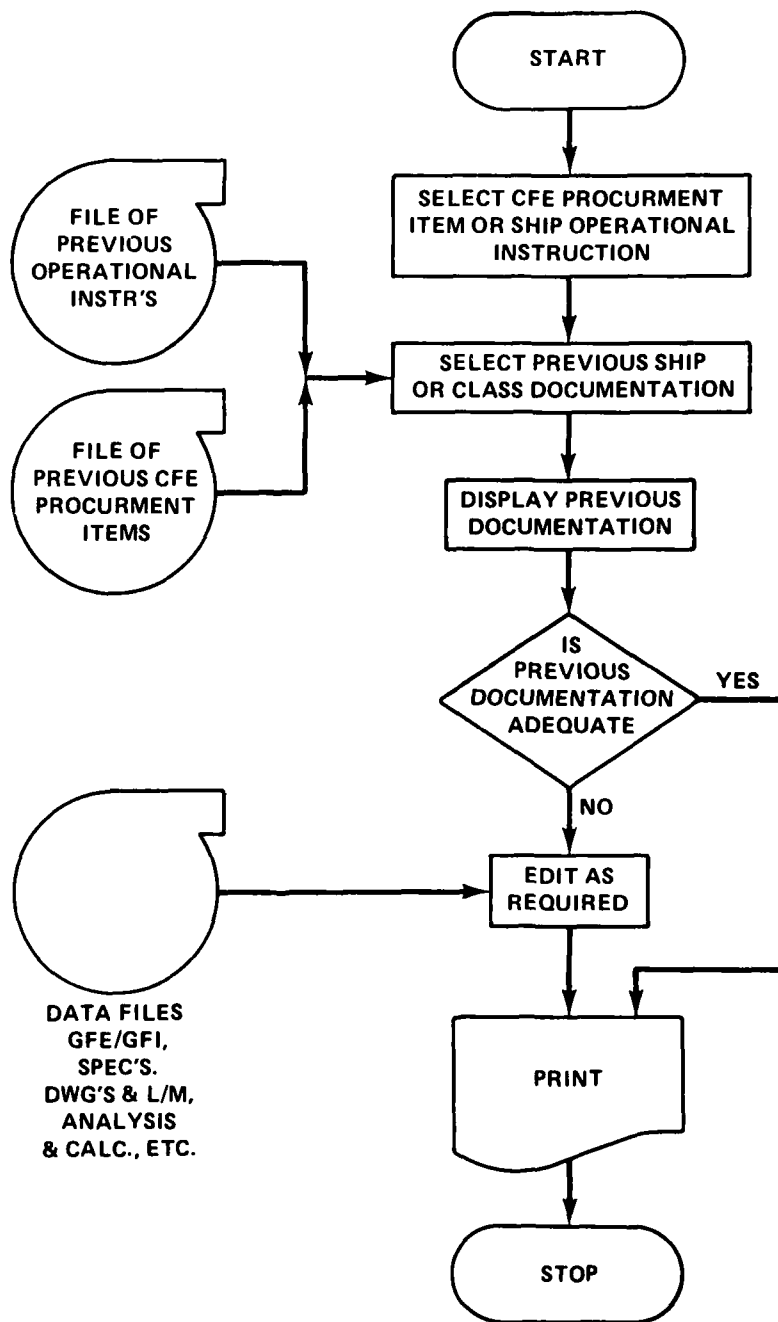
Input (Operational Documentation Only)

- Procurement Specifications for CFE

- Test Procedures

- Telephone Directory

Transform

The following description is an overview of the process shown in Figure IV-A1.

- The user will key in the name of the particular procurement item or operational instruction and the class of ship that is the same as or similar to the one he is working on or other key words which will activate the files.

- The selected documentation will be displayed or scrolled for review.

- If the user determines that the library formatted procurement specification or operational instruction is basically suited to the new requirements it is printed. If not, all necessary editing is accomplished by use of an interactive mode with a CRT.

- The user specifies distribution of the documentation.

- The user(s) repeats this procedure for all electrical/electronic procurement specifications and operational instructions.

Output

- Procurement Specification for CFE

- Operational Documentation

d. Hardware

The generalized hardware requirements for this subsystem are shown in Figure IV-A2. Typically this would include:

- Computer.

- Disk storage for catalogs.

- CRT display with cursor device for editing. Hard copy capability desirable.

- High-speed printer for preparation of text.
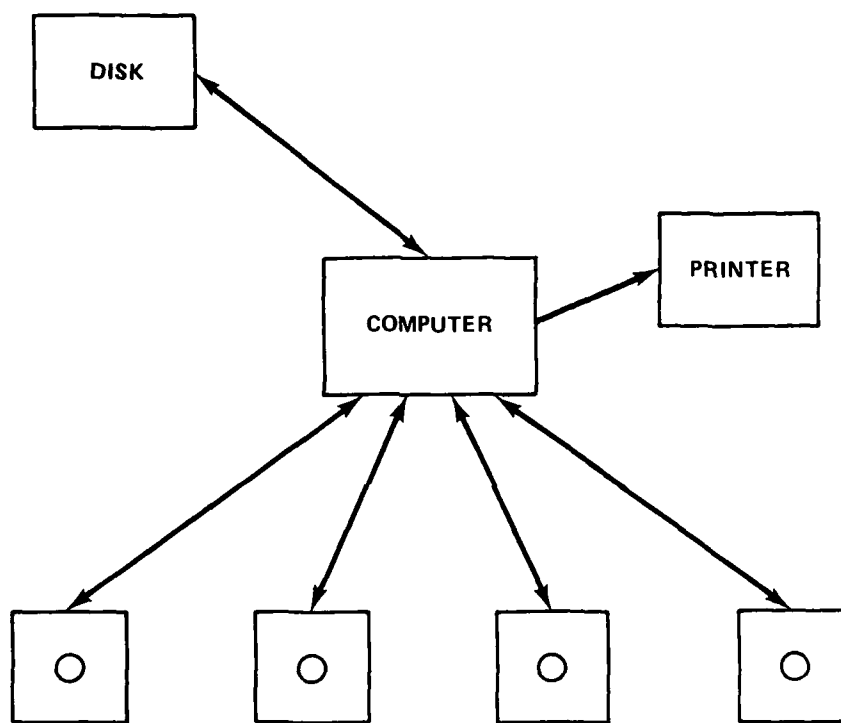
CRT TERMINALS WITH HARD COPY CAPABILITY

Figure IV-A2   Typical Hardware Configuration for Documentation System

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- **Pen type plotter for preparation of sketches and drawings that accompany procurement specifications and operational instructions or an electrostatic printer/plotter that would also provide above high-speed printer functions.

e.   Software

The computer-based environment for the stand-alone ELXDAC subsystem is described in Section III. The software for this subsystem would include a requirement for a text-editing system suited for creating procurement specifications and operational instructions.

f.   Data Base Support

The data base support is described in Section V of the Engineering Analysis. The data base ultimately required for this subsystem is:

- ELXDAC Support Software Numbers

  1, 2, 3, 4, 8, 22, 26, 29

- Catalog and Technical Information Numbers

  C-12, C-14, C-16, C-19

**Note: This is an option for simple modifications to existing diagrams and sketches. Utilize subsystem "D" - Drawing and Material Lists for the preparation of new drawings to accompany procurement specifications and operational instructions.

7.   ELXDAC STAND-ALONE SUBSYSTEM "B"

TITLE: Interface Data

a.   Background

The ELXDAC system comprises 10 stand-alone subsystems. Subsystem "B," "Inter-
face Data," is one of these systems. Interface data is defined as that data
developed in Level III design that is used as inut data for the Level IV design.
Although there may be some requirements in the Interface Data subsystem which are
unique to the ELXDAC system, the requirements of this system are basically common
to the CAPDAC, HULDAC, CAMDAC, and HVAC systems. In order to avoid duplication of
effort, the development of the Interface Data subsystem will be a joint effort by
the CASDAC systems.

Detail specifications, contract guidance drawings and Government Furnished
Equipment (GFE) lists are developed in Level III design and as such become the
input to Level IV design. In some instances the information developed in Level III
will be available in computer format. Computer programs (such as CSPAR) provide a
list of required combat system equipment for each compartment of a particular ship.
Also, the Electronic Design System computer graphics program will provide addi-
tional information about electrical/electronic equipment and equipment hook-up data
in computer format. The computer formats from these programs may not be compatible
with Level IV data base requirements; therefore, the Interface Data subsystem will
have to reformat the data for use in Level IV design.

The first task of the Level IV electrical designer is to determine which sys-
tems are to be developed, the number and types of drawings required for each system,
and to develop a drawing schedule that satisfies the need of the overall construc-
tion schedule.

In preparing the list of required systems, the designer must study the Level
III output in considerable detail and in so doing is often able to identify the in-
terfaces and interface data that relate to each system. This includes such data
as:

●   Inter/Intra System Hook-Up Requirements

●   Heating, Ventilation and Air Conditioning Requirements

●   Cableway Requirements

●   Power Requirements

that are required in the development of electrical/electronic systems. Some of
these interface data are known at the onset of Level IV design; however, consider-
able amounts of interface data, generated by disciplines other than electrical
during Level IV, are unavailable when the electrical system is being developed. To
reconcile this problem the designer proceeds with a design using judgements and
estimates based on previous ships and past experience.

b. Objective

The objective of the development of this subsystem is to provide a designer with a means to:

- Prepare an electrical design drawing schedule

- Obtain firm design requirements for interfaces in an easy manner

- Make estimates of requirements when firm values are not available

c. Description of System

The general description of the interface data system is shown in a flow chart, Figure IV-B1.

Input

- Detail specifications

- Contract guidance drawings

- Government-Furnished Equipment lists

- Production schedules

- Previous ship design data and past experience for generating estimated interface data

- Computer program CSPAR

- Electronic Design System computer graphics program

Transform

- A review is made of the detail specifications and other Level III design outputs.

- The user then develops an electrical design drawing schedule by:

    - establishing a list of required systems

    - determining the number and type of drawings/specifications/memoranda required for each system

    - integrating the required drawings with the construction schedule

- The user initializes a ship interface data file by:

Figure IV-B1
Sheet 1 of 3

SYMBOLS:

START OR COMPLETION OF A SERIES OF RELATED TASKS

OFF PAGE CONNECTORS- AA ARE TWO ALPHABETIC
CHARACTERS COMMON TO THE CONNECTION
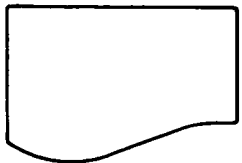
HARD COPY DOCUMENTS-LISTS, REPORTS, DRAWINGS, ETC.
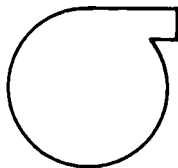
DATA FILES ON MAGNETIC MEDIA-TAPE OR DISK
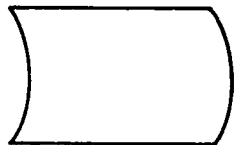
COMPUTER SOFTWARE

TASKS-AS SPECIFIED WITHIN THE BLOCK
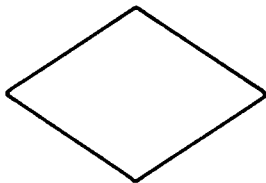
DECISIONS-AS SPECIFIED WITHIN THE BLOCK

Figure IV-B1   ELXDAC Stand-Alone Subsystem "B" Interface Data
Flow Chart

65

Figure IV-B1
Sheet 2 of 3

Figure IV-B1
Sheet 2 of 3

Figure IV-B1
Sheet 3 of 3


```
                              ┌───┐
                              │ A │
                              └─┬─┘
                                ▼
┌──────────────┐    ┌──────────────────┐
│   DETAIL     │    │  REVIEW DETAIL   │
│SPECIFICATIONS│───▶│ SPECIFICATIONS   │
│ & CONTRACT   │    │  AND CONTRACT    │
│  GUIDANCE    │    │    GUIDANCE      │
│  DRAWINGS    │    │    DRAWINGS      │
└──────────────┘    └────────┬─────────┘
                             ▼
┌──────────────┐    ┌──────────────────┐        ┌─────────────┐
│  PRODUCTION  │    │  ESTABLISH LIST  │        │    FILE-     │
│  SCHEDULES   │─┐  │   OF REQUIRED    │    ┌──▶ │  ELECTRICAL  │
└──────────────┘ │  │ ELECTRICAL SYSTEMS│    │    │   DESIGN     │
                 │  │ & NUMBER & TYPE  │    │    │   DRAWING    │
┌──────────────┐ ▼  │   OF DRAWINGS    │    │    │  SCHEDULE    │
│   DESIGN     │───▶│  SPECS/MEMOS     │───▶│    └─────────────┘
│  ADMINI-     │    │   REQ'D FOR      │    │
│  STRATION    │    │   EACH SYS-      │    │    ┌─────────────┐
└──────────────┘    │ DEVELOP DESIGN   │    └──▶ │  HARD COPY   │
                    │   SCHEDULE       │         │   OF FILE    │
┌──────────────┐    └────────┬─────────┘         └─────────────┘
│  COMPUTER    │───▶│
│  PROGRAM     │
│   CSPAR      │
└──────────────┘             ▼
                        ┌─────────┐
┌───────────────────┐   │  STOP   │
│ELECTRONIC DESIGN SYS.│ └─────────┘
│ COMPUTER GRAPHICS │
│    PROGRAM        │
└───────────────────┘
```

```
                              ┌───┐
                              │ B │
                              └─┬─┘
                                ▼
┌──────────────┐    ┌──────────────────┐
│   DETAIL     │    │     DEVELOP      │
│SPECIFICATIONS│─┐  │ INTERFACE FILE   │
│ & CONTRACT   │ │  │ CONTAINING LIST  │        ┌─────────────┐
│  GUIDANCE    │ │  │ OF OTHER SYSTEMS │        │    SHIP      │
│  DRAWINGS    │ │  │ & DISCIPLINES    │    ┌──▶ │  INTERFACE   │
└──────────────┘ │  │ THAT INTERFACE   │    │    │    DATA      │
                 ▼  │WITH EACH ELECTRICAL│   │    │    FILE      │
┌──────────────┐───▶│  SYSTEM INCL ANY │───▶│    └─────────────┘
│INFO FROM OTHER│   │  KNOWN INTERFACE │    │
│ DISCIPLINES & │   │  DATA THAT WILL  │    │    ┌─────────────┐
│  INTERFACES   │   │   BE REQ'D IN    │    └──▶ │  HARD COPY   │
└──────────────┘    │   DEVELOPING     │         │   OF FILE    │
                    │   THE SYSTEM     │         └─────────────┘
┌──────────────┐───▶└────────┬─────────┘
│    DATA      │             │
│ MANAGEMENT   │             ▼
│ APPLICATION  │        ┌─────────┐
│  SOFTWARE    │        │  STOP   │
└──────────────┘        └─────────┘
┌──────────────┐
│  COMPUTER    │
│  PROGRAM     │
│   CSPAR      │
└──────────────┘
┌───────────────────┐
│ELECTRONIC DESIGN SYS.│
│ COMPUTER GRAPHICS │
│    PROGRAM        │
└───────────────────┘
```

●● recording other systems and disciplines that interface with each
   electrical or electronic system

   ●● determining interface data from other systems and disciplines that
   interface with each electrical or electronic system

● The ship interface data file is queried and data retrieved, if available.
  If interface data is not available on the ship interface data file a query
  is made to the interface data library file and estimated data values are
  retrieved and entered on a ship estimated interface data file.

Output

● Electrical design drawing schedule

● Ship interface data file

● Ship estimated interface data file

● Reformatted Level III data base information

d.   Hardware

   The generalized hardware requirements for this subsystem are shown in Figure
IV-B2. Typically this would include:

● Computer

● Fixed disk storage for interface data

● Removable disk or tape input device for Level III data

● CRT terminals for query, update and hard copy

● Printer for large volume of data

e.   Software

   The computer-based environment for the stand-alone ELXDAC subsystem is described
in Section III. The software for this subsystem would include a requirement for a
query and update capability suited for obtaining and updating the interface data.

f.   Data Base Support

   The data base support is described in Section V of the Engineering Analysis.
The data base ultimately required for this subsystem is:

● ELXDAC Support Software Numbers 1, 2, 3, 4, 26

● Schedules

● Catalog and Technical Information Numbers C-2, C-18, C-20, C-21

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FIXED DISK

REMOVABLE DISK

COMPUTER

PRINTER

CRT TERMINALS WITH HARD COPY CAPABILITY
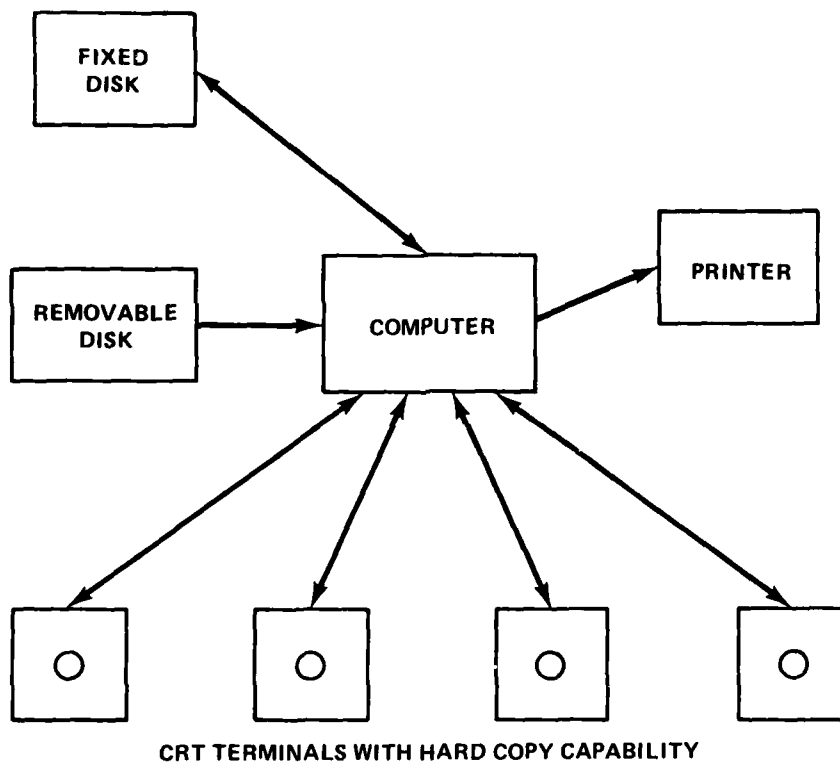
Figure IV-B2   Typical Hardware Configuration for Interface Data Subsystem

8.   ELXDAC STAND-ALONE SUBSYSTEM "D"

TITLE: Drawing and Material List

a.   Background

The ELXDAC system comprises 10 stand-alone subsystems. Subsystem "D,"
"Drawing and Material List," is one of these systems.

Detail specifications, contract guidance drawings, GFE/GFI, equipment lists,
vendor data, various arrangement and composite drawings, wireway sizing and routing,
system analysis and calculations and preliminary electrical/electronic studies all
become the input to Level IV design. The first task of the Level IV electrical de-
signer is to review the above inputs in order to produce the required drawings and
material lists.

b.   Objective

The objective of the development of this subsystem is to provide an electrical
engineer or designer with a means to:

- Develop Schematic Drawings

- Develop Elementary Drawings

- Develop Isometric Drawings and List of Materials

- Develop Hook-Up Lists

- Develop Standard Method Drawings

- Develop Design Division Instructions

c.   Description of System

The general description of the drawing and material list system is shown in a
flow chart, Figure IV-D1.

Input

- Detail Specifications

- Contract Guidance Drawings

- GFE/GFI

- Equipment Lists

- Vendor Data

- Arrangement Drawings

70

Figure IV-D1
Sheet 1 of 2

**SYMBOLS:**

START OR COMPLETION OF A SERIES OF RELATED TASKS

OFF PAGE CONNECTORS- AA ARE TWO ALPHABETIC
CHARACTERS COMMON TO THE CONNECTION

HARD COPY DOCUMENTS-LISTS, REPORTS, DRAWINGS, ETC.
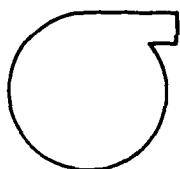
DATA FILES ON MAGNETIC MEDIA-TAPE OR DISK

COMPUTER SOFTWARE
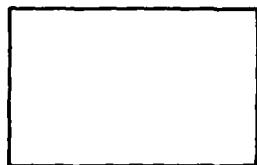
TASKS-AS SPECIFIED WITHIN THE BLOCK
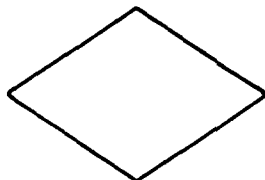
DECISIONS-AS SPECIFIED WITHIN THE BLOCK

Figure IV-D1   ELXDAC Stand-Alone Subsystem "D" Drawings and Material
List Flow Chart

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Figure IV-D1
Sheet 2 of 2

START

FILE OF
DWG
SCHED.

SELECT ELEC/ELEX DWG
TO BE PREPARED
FROM DWG SCHEDULE

FILE OF
CONTRACT
GUIDANCE
DWG'S

DISPLAY CONTRACT
GUIDANCE DWG
OF SELECTED
DWG TO BE
PREPARED

DATA FILES
SPEC'S, GFE/
GFI, ARRGT
ETC.

FILE OF
PAST
DESIGNS

INCORPORATE REQUIRED
CHANGES ON THE CONTRACT
GUIDANCE DWG TO PRODUCE
DETAIL DESIGN DWG

FILE OF
DETAIL
DESIGN
DWG

PREPARE
LIST OF
MATERIALS

FILE OF
MATERIAL
CONTROL

INCORPORATE L/M ON
DETAIL DESIGN DWG

PRINT DETAIL
DESIGN DWG
AND LIST OF
MATERIALS

STOP

72

- Composite Drawings

- Wireway Sizing and Routing

- System Analysis and Calculations

- Preliminary Electrical/Electronic Studies

Transform

The following description is an overview of the process shown in Figure IV-D1.

- The designer selects an electrical/electronic drawing to be prepared from the drawing schedule

- A copy of the applicable contract guidance drawing is then displayed on the CRT.

- The designer reviews all other applicable input data for the selected drawing.

- The designer reviews similar drawings from past designs.

- The designer then incorporates required changes on the contract guidance drawing to create the detail design drawing.

- The designer prepares a list of materials with the information available from the detail design drawing and "material control."

- The list of materials is then incorporated on the detail design drawing.

Output

- Schematic Drawings

- Elementary Drawings

- Isometric Drawings and List of Materials

- Hook-Up Lists

- Standard Method Drawings

- Design Division Instructions

d.   Hardware

The generalized hardware requirements for this subsystem are shown in Figure IV-D2. Typically this would include:

73
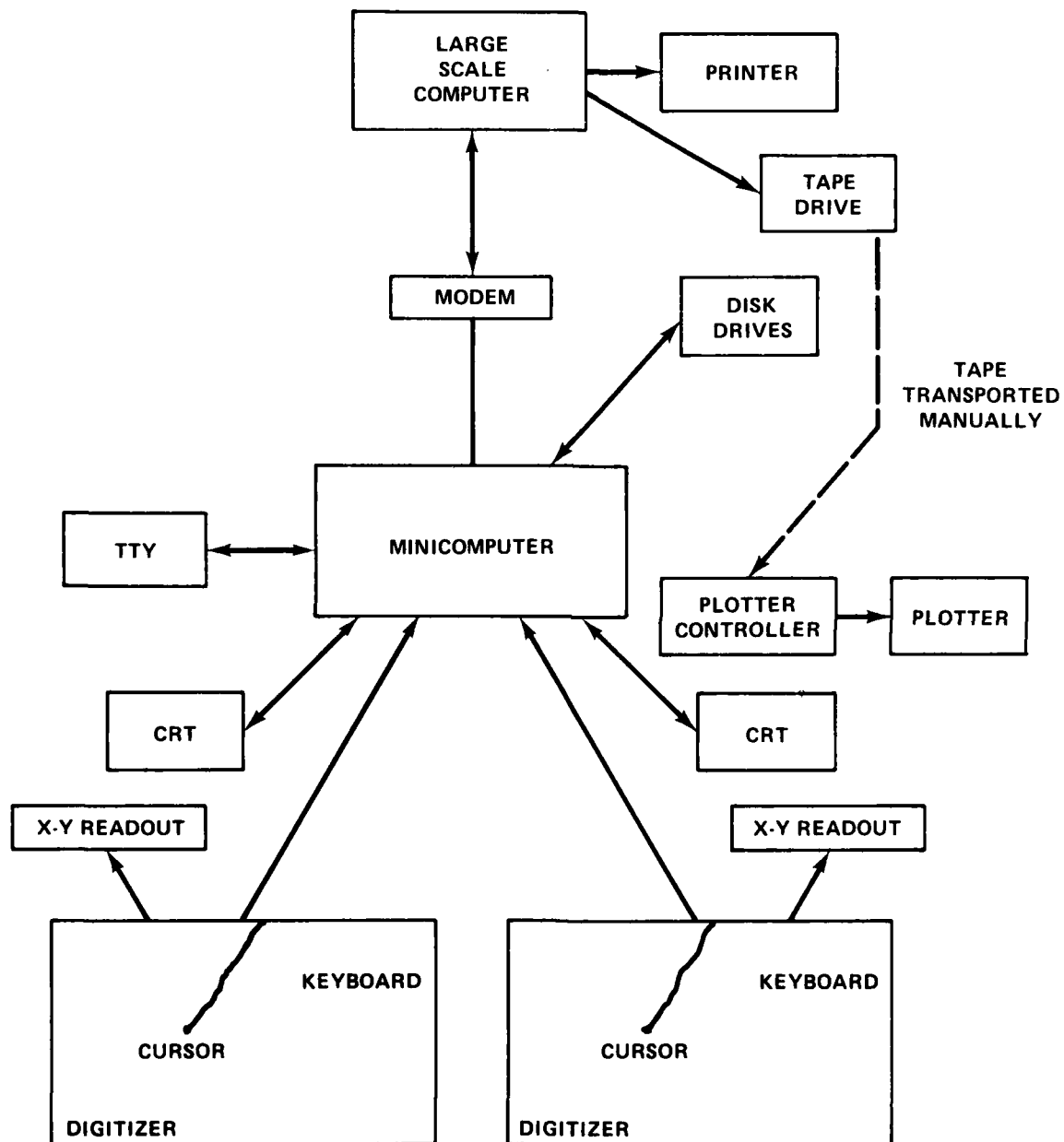
Figure IV-D2   Typical Graphic Data Reduction and Design Station-
Two Digitizers

74

- Minicomputer

- Disk Storage

- CRT(s)

- X - Y Readout(s)

- Digitizer(s) (Keyboard and Cursor)

- Off-Line Plotter

- Teletype

e. Software

The computer-based environment for the stand-alone ELXDAC subsystem is de-scribed in Section III. The software will include several analysis programs related to producing the various types of electrical/electronic drawings.

f. Data Base Support

The data base support is described in Section V of the Engineering Analysis. The data base ultimately required for this subsystem is:

- ELXDAC Support Software Numbers

  1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17, 19, 21, 22, 23, 24, 26, 27

- Catalog and Technical Information Numbers

  C-1, C-2, C-3, C-4, C-8, C-11, C-12, C-13, C-14, C-17, C-18, C-19, C-20,

  C-21, C-22

9. ELXDAC STAND-ALONE SUBSYSTEM "J"

TITLE: Cabling and Wiring

a. Background

The ELXDAC system comprises 10 stand-alone subsystems. Subsystem "J," "Cabling and Wiring," is one of these systems. Early work in this area began with the development of the Cabling/Wiring System 2 (C/W2) computer program.

The Cabling and Wiring Subsystem will be used for the preparation of wireway details.

b. Objective

The objective of the development of this subsystem is to provide an electrical engineer or designer with a means to develop wireway details which will include:

- Cable Hanger Details

- Main Cableway Layout

- Power System Deck Plans

- Lighting System Deck Plans

- Waveguide/Transmission Line Drawings

c. Description of System

The general description of the cabling and wiring system is shown in Figure IV-J1.

Input

- Detail Specifications

- Contract Guidance Drawings

- GFE/GFI

- Equipment Lists

- Vendor Data

- Arrangement Drawings

- Composite Drawings

- Hull System Engineering

- Hull Detail Design/Structural Detail Design

- ELXDAC Drawings and Lists of Material

- ELXDAC System Analysis and Calculations

- ELXDAC Preliminary Studies

- Design Integration

Transform Capabilities

The following description is an overview of the process shown in Figure IV-J1.

Cable Hanger Details

The designer prepares cable hanger details by determining the number and size of cable tiers.

Main Cableway Layout

The designer provides locations and dimensions of main cableways. He also prepares proportional plan views and inboard profiles as well as indicating transits used for penetration of decks and bulkheads.

Power System Deck Plans

The designer prepares power system deck plans by providing drawings showing power distribution from distribution panels to the user equipment, i.e., motors, controllers, and receptacles. Also, manual and automatic control devices are indicated including associated wiring.

Lighting System Deck Plans

The designer prepares lighting system deck plans by producing drawings showing lighting distribution from distribution panels to lighting fixtures and appliances in accordance with arrangement drawings.

Waveguide/Transmission Line Drawings

The designer prepares waveguide/transmission line drawings by producing drawings showing signal paths as described on the missile system, gunnery system, radar system and early warning system. The designer procures special equipment requirements and provides information to hull on penetrations and information to piping on dry-air requirements.

Output

The output of the cabling and wiring system consists of the following wireway details:

Figure IV-J1
Sheet 1 of 2

SYMBOLS:

START OR COMPLETION OF A SERIES OF RELATED TASKS

OFF PAGE CONNECTORS- AA ARE TWO ALPHABETIC
CHARACTERS COMMON TO THE CONNECTION

HARD COPY DOCUMENTS-LISTS, REPORTS, DRAWINGS, ETC.

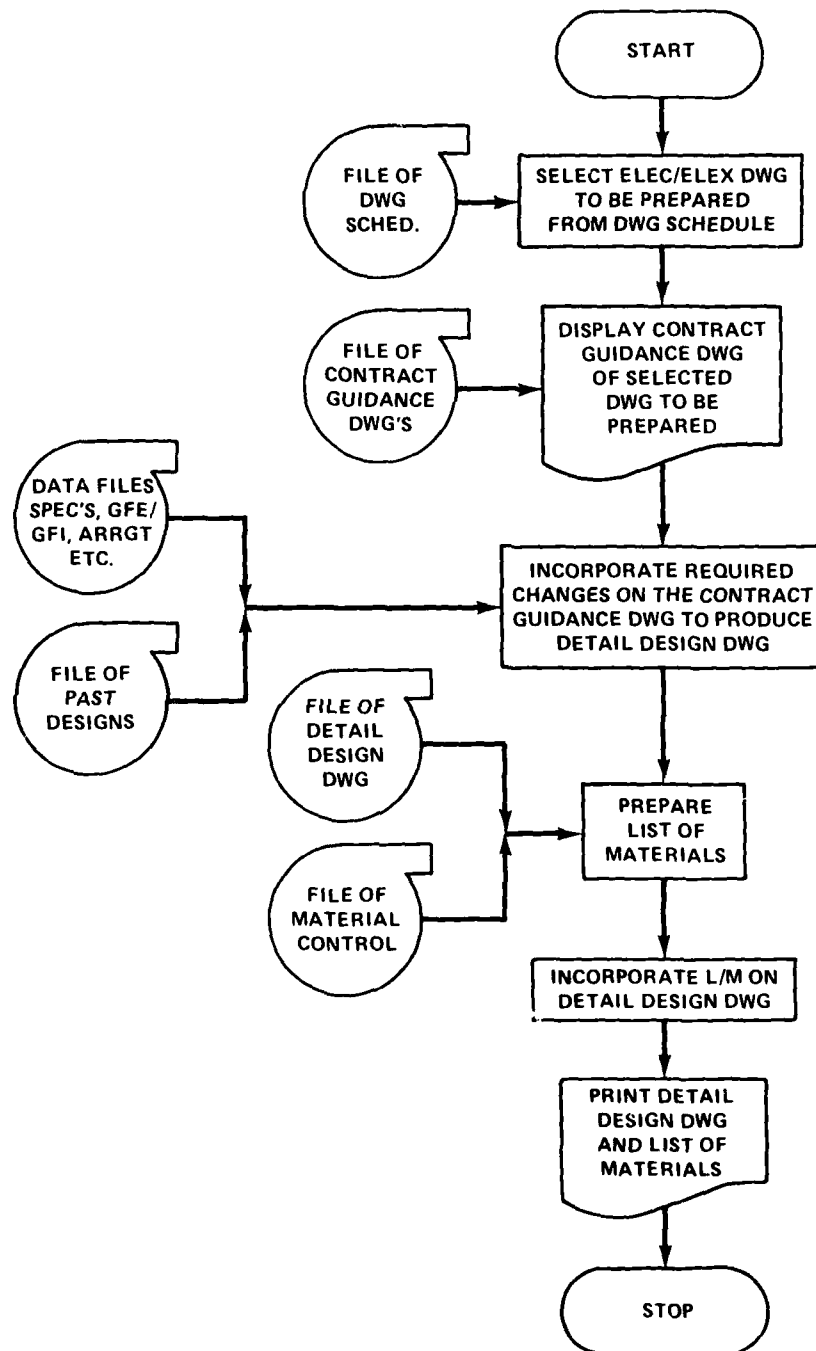DATA FILES ON MAGNETIC MEDIA-TAPE OR DISK

COMPUTER SOFTWARE

TASKS-AS SPECIFIED WITHIN THE BLOCK

DECISIONS-AS SPECIFIED WITHIN THE BLOCK
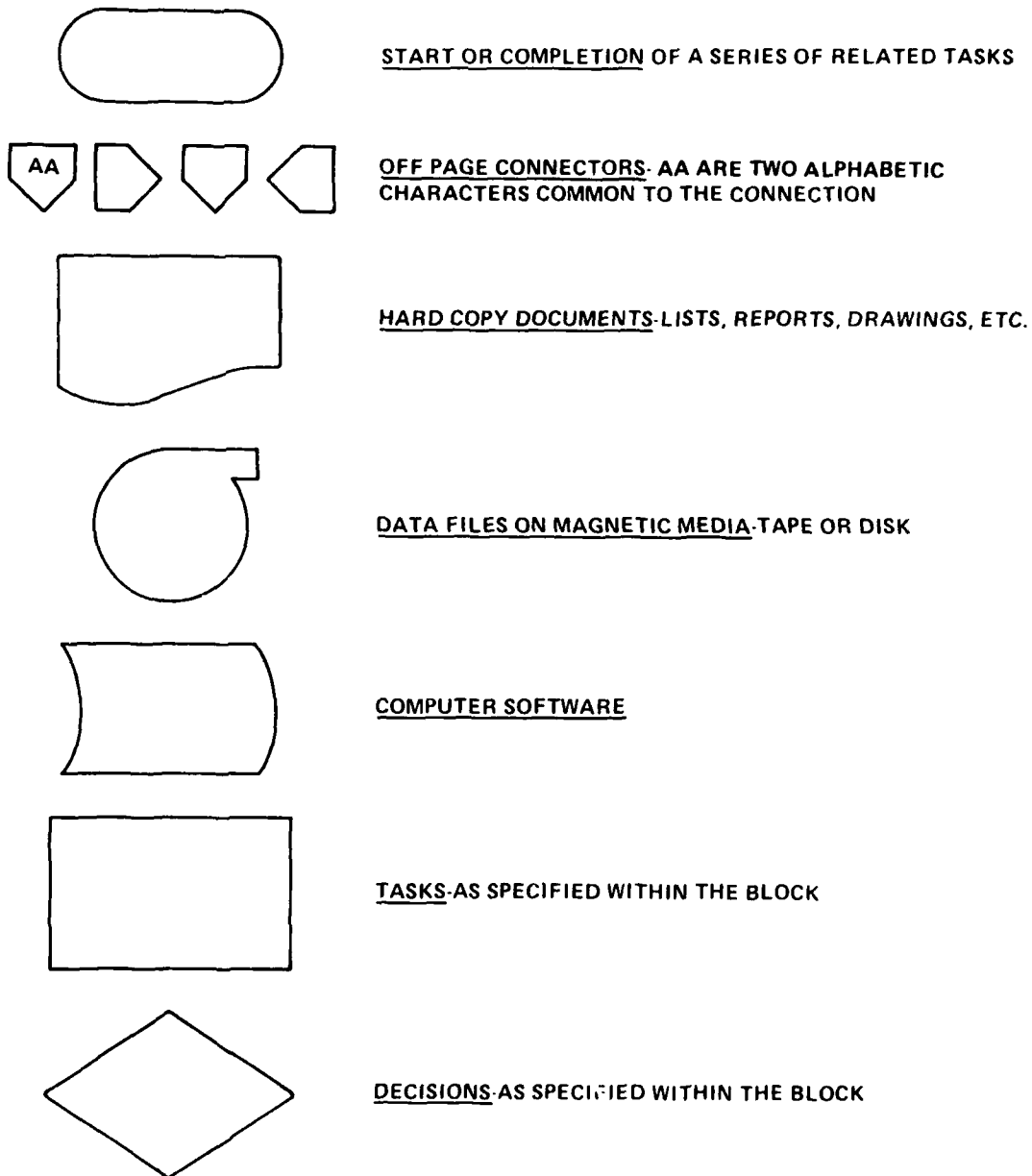
Figure IV-J1 ELXDAC Stand-Alone Subsystem "J" Cabling and Wiring
            Overview Chart

Figure IV-J1
Sheet 2 of 2
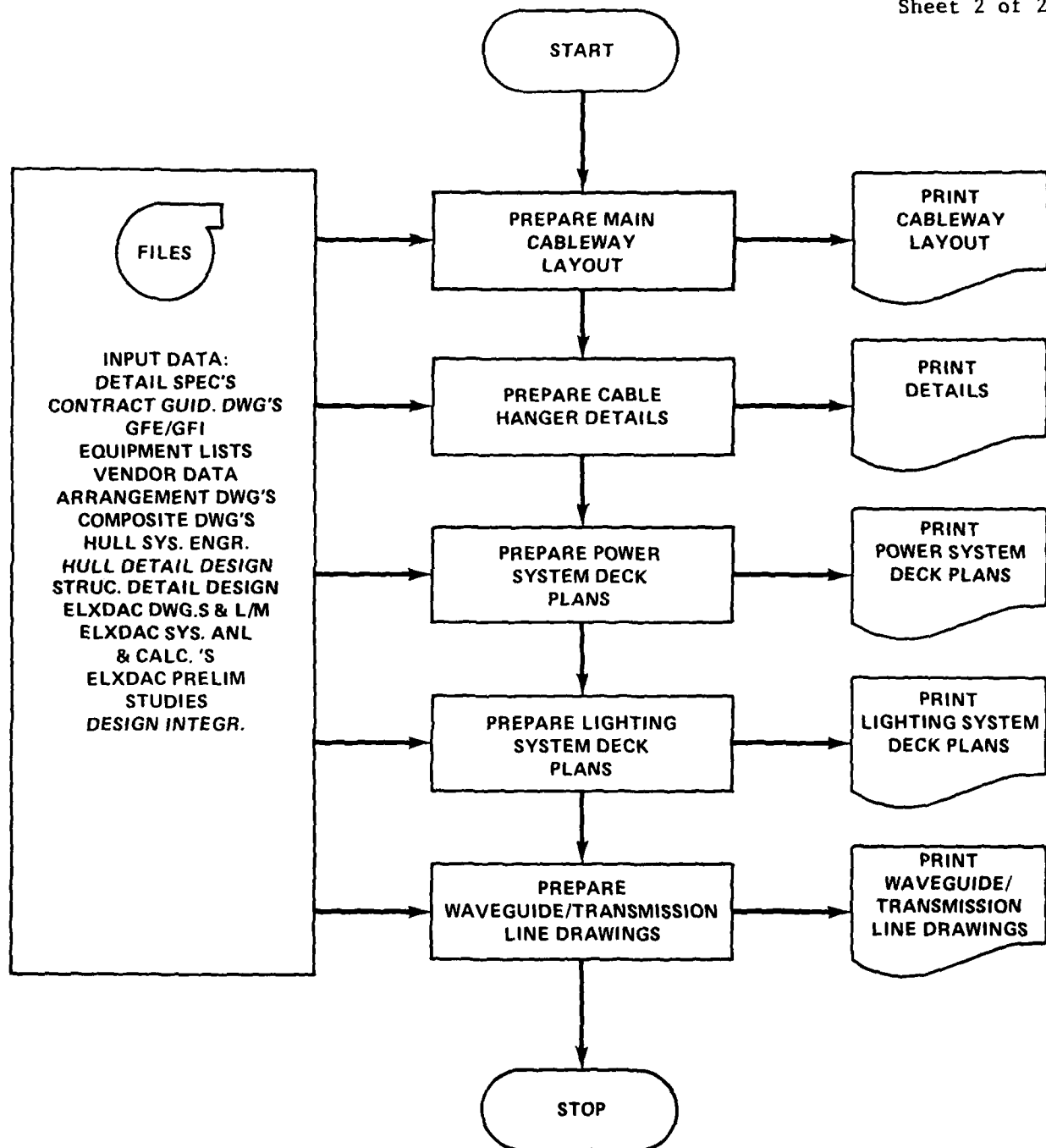
- Cable Hanger Details

- Main Cableway Layout

- Power System Deck Plans

- Lighting System Deck Plans

- Waveguide/Transmission Line Drawings

d. Hardware

The generalized hardware requirements for the subsystem are shown in Figure IV-J2. Typically this would include:

- Minicomputer

- Disk Storage

- CRT(s)

- X - Y Readout(s)

- Digitizer(s) (keyboard and cursor)

- Off-Line Plotter

- Teletype

e. Software

The computer-based environment for the stand-alone ELXDAC subsystem is described in Section III. The software will include analysis programs related to producing the various types of electrical/electronic drawings.

f. Data Base Support

The data base support is described in Section V of the Engineering Analysis. The data base ultimately required for this subsystem is:

- ELXDAC Support Software Numbers

    1, 2, 3, 4, 5, 6, 7, 10, 13, 14, 15, 16, 17, 18, 23, 25, 26, 27

- Catalog and Technical Information Numbers

    C-6, C-11, C-12, C-13, C-14, C-17, C-18, C-19, C-20, C-22
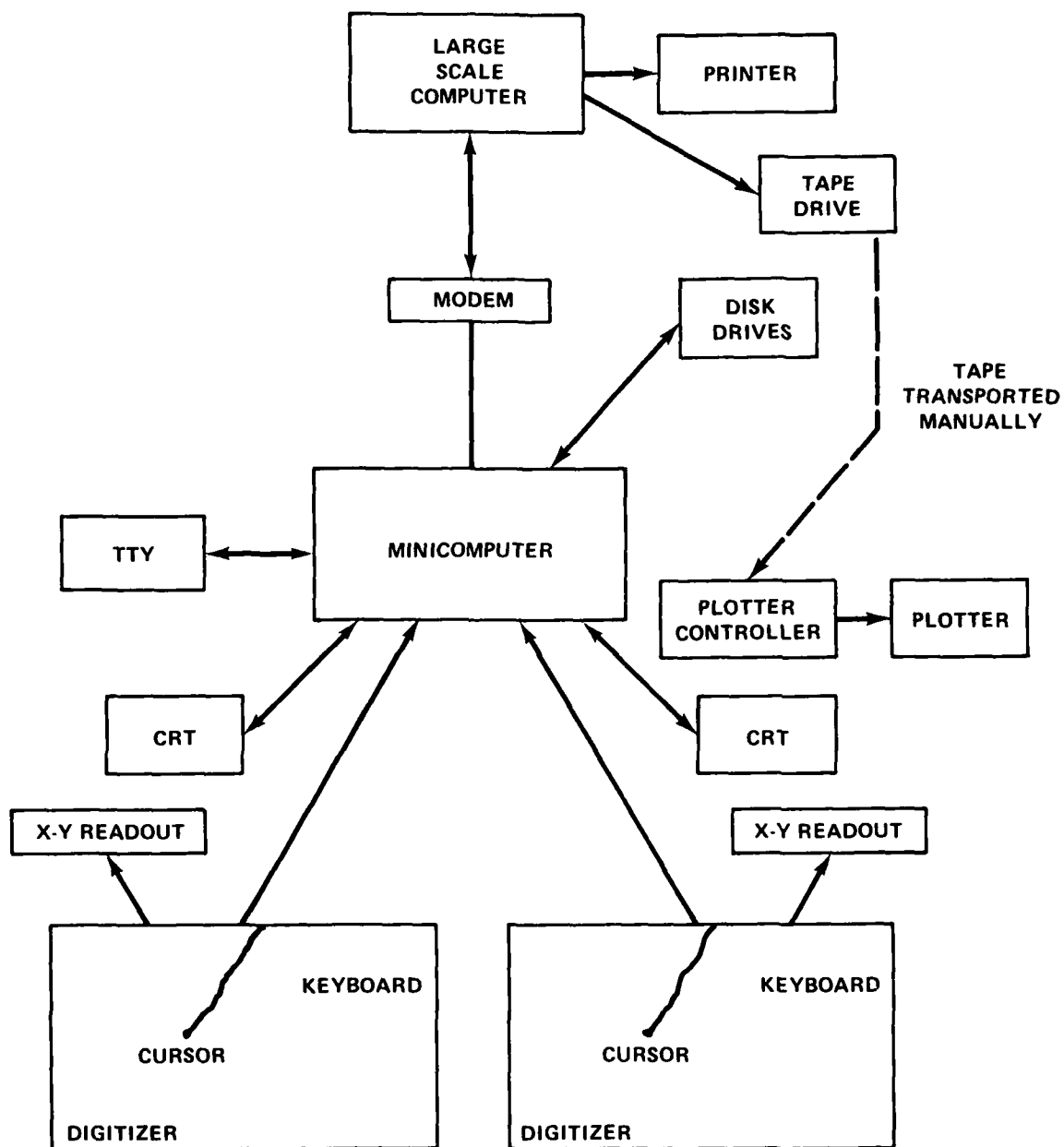
Figure IV-J2   Typical Graphic Data Reduction and Design Station-
                Two Digitizers

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10. ELXDAC STAND-ALONE SUBSYSTEM "E"

TITLE: Scientific and Engineering

a. Background

The ELXDAC system comprises 10 stand-alone subsystems. Subsystem "E", "Scientific and Engineering," is one of these systems.

Detail specifications, contract guidance drawings, GFE/GFI equipment lists, vendor data, various arrangement and composite drawings, wireway sizing and routing and applicable preliminary scientific and engineering calculations all become the input to Level IV design. The electrical designer's task is to review the above inputs in order to produce the required scientific and engineering calculations.

b. Objective

The objective of the development of this subsystem is to provide an electrical engineer or designer with a means to calculate:

- Load Analysis

- Voltage Drop

- Fault Current

- Load Shedding

- Synchro Load Analysis

- Degaussing Calculations

- Illumination Analysis

- HVAC Analysis

- EMI/Grounding Analysis

- Weight/Moment Analysis

- Cable Heat Dissipation Analysis

- Cable Separation Requirements

- Cable Routing

- Cable/Cableways Estimates

- Antenna Modeling

- Combat System Modeling

- Sizing

- CW-2 Program (Hook-Up)

c. Description of System

The general description of the scientific and engineering system is shown in Figure IV-E1.

Input

- Detail Specifications

- Contract Guidance Drawings

- GFE/GFI

- Equipment Lists

- Vendor Data

- Arrangement Drawings

- Composite Drawings

- Wireway Sizing and Routing

- Applicable Preliminary Scientific and Engineering Calculations

Transform Capabilities

The following description is an overview of the process shown in Figure IV-E1.

Load Analysis

The designer tabulates and distributes loads evenly on each of the three phases of the power, lighting and I.C. circuits.

Voltage Drop

The designer performs voltage drop calculations based upon cable length and impedance along with system voltage level.

DDS-9620-2 is used to perform voltage drop calculations.

Fault Current

The designer performs fault current analysis using the power system elementary wiring diagram, known characteristics of the SSG's, estimated characteristics of the operating motors, feeders, bus ties, and circuit breakers.

DDS-9620-3 is used to calculate fault current.

Figure IV-E1
Sheet 1 of 2

SYMBOLS:

START OR COMPLETION OF A SERIES OF RELATED TASKS

OFF PAGE CONNECTORS- AA ARE TWO ALPHABETIC
CHARACTERS COMMON TO THE CONNECTION

HARD COPY DOCUMENTS-LISTS, REPORTS, DRAWINGS, ETC.

DATA FILES ON MAGNETIC MEDIA-TAPE OR DISK

COMPUTER SOFTWARE

TASKS-AS SPECIFIED WITHIN THE BLOCK

DECISIONS-AS SPECIFIED WITHIN THE BLOCK
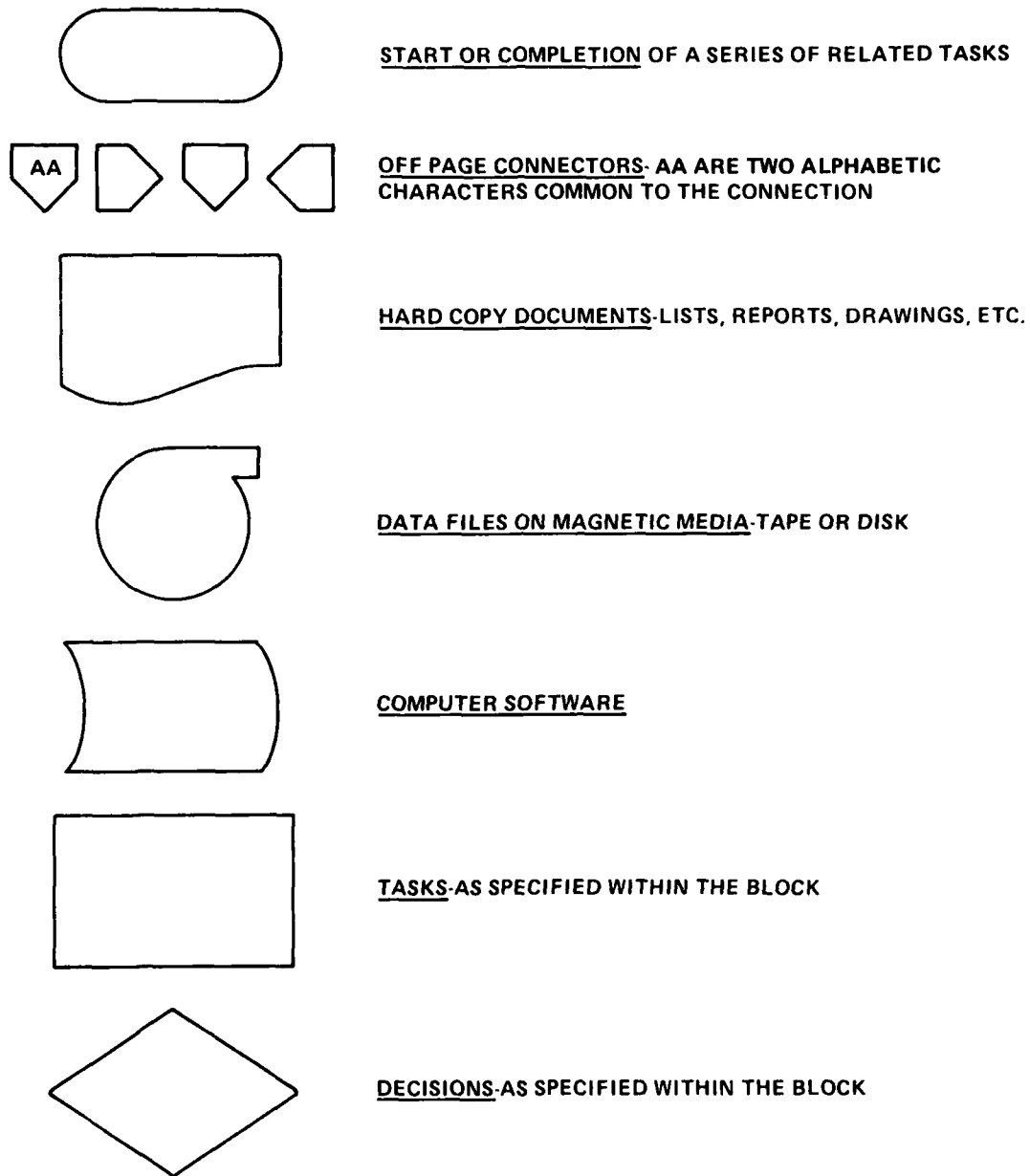
Figure IV-E1   ELXDAC Stand-Alone Subsystem "E" Scientific and
Engineering Overview Chart

Figure IV-El
Sheet 2 of 2

START

FILES

INPUT DATA:
DETAIL SPEC'S
CONTRACT GUID. DWG'S
GFE/GFI
EQUIPMENT LISTS
VENDOR DATA
ARRG'T DWG'S

COMPOSITE DWG'S
WIREWAY SIZING &
ROUTING
APPLIC. PRELIM.
SCI. & ENGR. CALC'S

SCIENTIFIC & ENGINEERING
OPTIONS:
LOAD ANALYSIS
VOLTAGE DROP
FAULT CURRENT
LOAD SHEDDING
SYNCHRO LOAD ANALYSIS
DEGAUSSING CALC'S
ILLUM. ANALYSIS
HVAC ANALYSIS
EMI/GROUNDING ANALYSIS
WEIGHT/MOMENT ANALYSIS
CABLE HEAT DISSIPATION ANALYSIS
CABLE SEPARATION REQ'TS
CABLE ROUTING
CABLE/CABLEWAY ESTIMATES
ANTENNA MODELING
COMBAT SYS MODELING
SIZING
CW-2 PROGRAM

PRINT
RESULTS

STOP

Load Shedding

The designer determines the sequencing of equipment shutdown in order to minimize loads during casualty conditions.

Synchro Load Analysis

The designer determines the quantity of synchro load amplifiers required to support control and torque synchro loads.

NAVSEA Drawings 815-1853311 and DDS-9650-2 are used for this analysis.

Degaussing Calculations

The designer determines placement of the coils and calculates amperage per loop and the total amperages for the purpose of sizing the power supplies.

Illumination Analysis

The designer prepares deck drawings indicating the locations in each compartment in which foot-candle illumination levels are to be obtained.

HVAC Analysis

The designer determines cooling, heating, and dry air requirements for electrical/electronic equipment and provides the information to the appropriate disciplines.

EMI/Grounding Analysis and Cable Separation Requirements

The designer determines shielding and separation requirements for low-level signal cables. Proper bonding techniques for grounding of cable sheaths and equipment are also determined.

Weight/Moment Analysis

The designer performs a weight and moment analysis with use of equipment weights and locations and provides the information to hull personnel.

Cable Heat Dissipation Analysis

The designer determines the effects of cable heating within wireways with the use of cable de-rating factors. Cable routes and/or wireways may be modified based on results.

Cable Routing

The designer identifies cable route numbers, locations and dimensions of main cableways, and penetration numbers. The designer provides a reference table of transit assignments to cables and sizing of transits for bulkhead penetrations.

Cable/Cableway Estimates

The designer estimates total ship requirements for various cable sizes and types. The designer also determines the number of cableways required for the construction of the ship.

Sizing

The designer determines the proper size, type and rating of components (transformers, MG Sets, cables, amplifiers, fuses, circuit breakers, switches, etc.).

DDS-9610-3 is used for voltage dip calculations.

DDS-9620-5 is used for cable sizing.

DDS-9620-4 is used for sizing protective devices.

Antenna Modeling

The designer determines the location of the ship's antennas by predicting radiation patterns and required antenna impedances.

Combat System Modeling

The designer determines the most feasible combat system suite that best serves the mission of the ship.

CW-2 Program (Hook-Up)

The designer uses the CW-2 program to produce documents which aid the ship mechanic to perform the tasks of installing and hooking-up electrical/electronic shipboard systems.

Output

The output of the scientific and engineering system consists of the following calculations, analysis and modeling data:

- Load Analysis

- Voltage Drop

- Fault Current

- Load Shedding

- Synchro Load Analysis

- Degaussing Calculations

- Illumination Analysis

- HVAC Analysis

- EMI/Grounding Analysis

- Weight/Moment Analysis

- Cable Heat Dissipation Analysis

- Cable Separation Requirements

- Cable Routing

- Cable/Cableway Estimates

- Antenna Modeling

- Combat System Modeling

- Sizing

- CW-2 Program (Hook-Up)

d. Hardware

The generalized hardware requirements for this subsystem are shown in Figure IV-E2. Typically this would include:

- Minicomputer

- Disk Storage

- CRT(s)

- X - Y Readout(s)

- Digitizer(s) (Keyboard and Cursor)

- Off-Line Plotter

- Teletype

e. Software

The computer-based environment for the stand-alone ELXDAC suosystem is described in Section III. The software will include the analysis programs as described in paragraph c. above.

f. Data Base Support

The data base support is described in Section V of the Engineering Analysis. The data base ultimately required for this subsystem is:
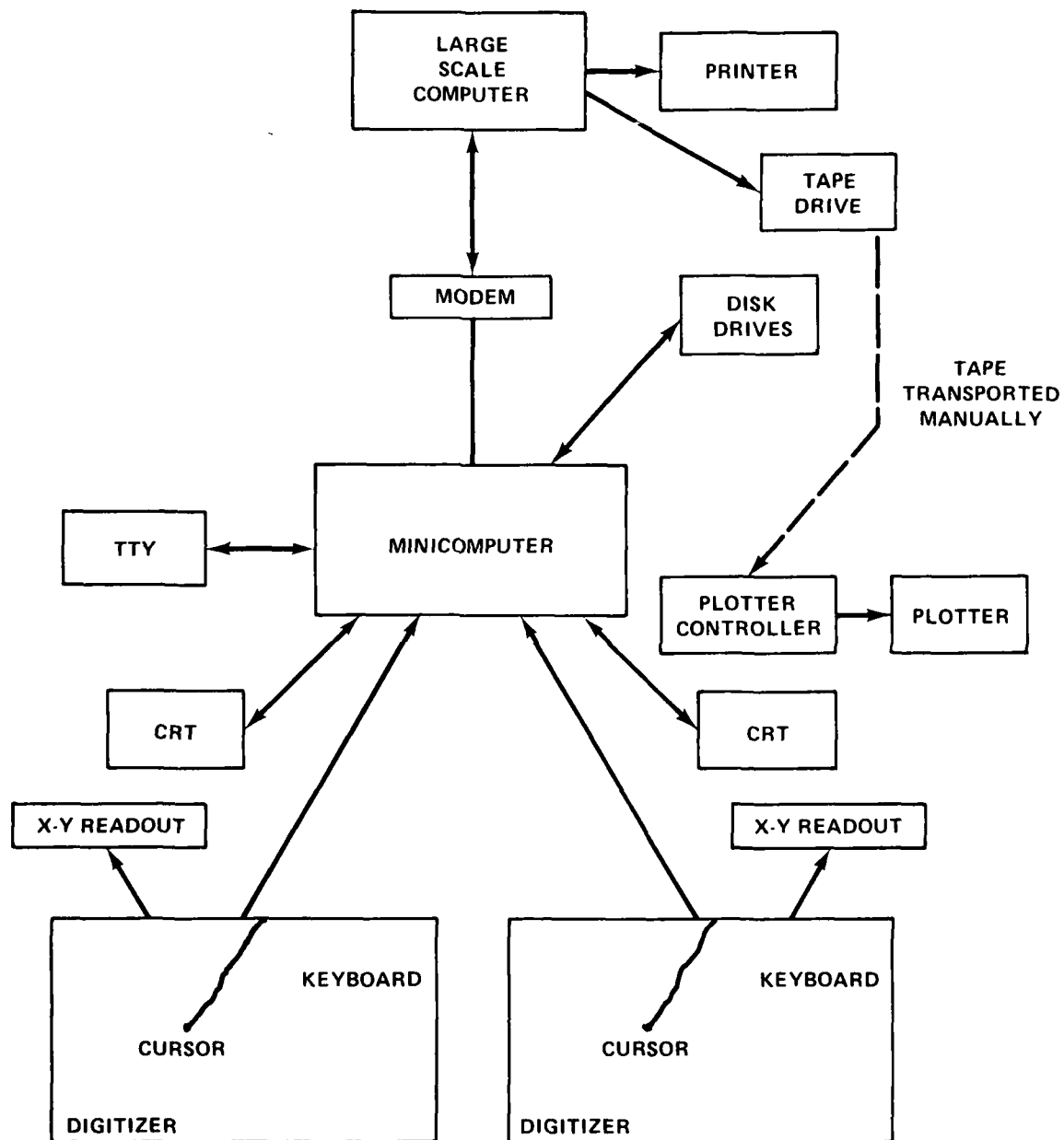
Figure IV-E2   Typical Graphic Data Reduction and Design Station-
Two Digitizers

- ELXDAC Support Software Numbers

  1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21,

  25, 26

- Catalog and Technical Information Numbers

  C-5, C-12, C-17

V. ELXDAC DATA BASE

A. INTRODUCTION

The ELXDAC Data Base comprises:

- Support Software (includes application programs)

- Catalog Data

- Design Guidelines

- Design Data

The acquisition and development of the ELXDAC Data Base will be the largest effort within the scope of the ELXDAC project. The purpose of this section is to define the data base at a functional level. These functional definitions will provide the basis for the further development and procurement of the data base. The development of these specifications is not part of this engineering analysis.

B. LEVEL IV DESIGN DATA BASE

1. Support Software

The following are the support software packages that will be developed for the ELXDAC system.

ELXDAC SUPPORT SOFTWARE NUMBER	BRIEF DESCRIPTION OR TITLE
1	Central Control System Software (CCSS)
2	Executive System (Part of CCSS)
3	Design Administration (Part of CCSS)
4	Data Management System (Part of CCSS)
5	Load Analysis
6	Voltage Drop
7	Fault Current
8	Load Shedding
9	Synchro Load Analysis
10	Degaussing Calculations
11	Illumination Analysis
12	HVAC Analysis
13	EMI/Grounding and Cable Separation Requirements Analysis
14	Weight and Moment Analysis
15	CW-2 Program (Hook-Up)
16	Cable Heat Dissipation Analysis
17	Cable Routing
18	Cable/Cableways Estimates
19	Antenna Modeling
20	Combat System Modeling

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```
ELXDAC
SUPPORT
SOFTWARE
NUMBER                  BRIEF DESCRIPTION OR TITLE

  21              Deck Lighting
  22              Equipment Lists and Summaries
  23              Drafting Package -2D
  24              Drafting Package -3D
  25              Interference Detection
  26              File Search/Query
  27              Automatic Labeling
  28              COM for Labeling
  29              Report Generator/Editor
```

The following is a synopsis of each of the above support software packages.

ELXDAC SUPPORT SOFTWARE NO. 1

TITLE: CENTRAL CONTROL SYSTEM SOFTWARE (CCSS)

ELXDAC SUPPORT SOFTWARE NO. 2

TITLE: EXECUTIVE SYSTEM (PART OF CCSS)

ELXDAC SUPPORT SOFTWARE NO. 3

TITLE: DESIGN ADMINISTRATION (PART OF CCSS)

ELXDAC SUPPORT SOFTWARE NO. 4

TITLE: DATA MANAGEMENT SYSTEM (PART OF CCSS)

The following is the general description of ELXDAC Support Software Numbers 1 to 4, inclusive.

Central Control System Software

Central control system software consists of general-purpose software tools that can be used to build and manage an interactive system of integrated application programs and data files which can be easily used in a controlled computer environment.

Central control system software, in the context of this definition, is not supplied by the computer manufacturers. Various features, such as data management systems, are available but the total concept is not. There are currently several efforts underway to develop such overall systems. NASA's "IPAD" system is an example of such an attempt to provide a general system support for a project such as the ELXDAC Subsystem. A system such as CCSS will either need to be developed or adapted from an existing system such as IPAD. As the ELXDAC system evolves and interaction continues with the marine industry, the expectations are that the

explicit requirements of the central system software will be more finely defined in terms of the end-users' needs.

Central control system software should consist of three major components as described below:

- Executive System – An interactive supervisor with facilities to define and use integrated application systems composed of related command procedures. Command procedures can represent the tasks or functional capabilities of a system and each can be designed with a convenient user interface. Command procedures can perform a series of either simple or complex computer operations such as, prompting the user, automatically obtaining files and executing programs, altering the sequence of operations based on user or program decision, executing system control cards, and submitting batch jobs. Access to commands can be controlled, allowing their use by valid users only.

- Data Management System – A capability for defining and randomly processing large data bases on-line which can have either simple or complex data structures. Following data definition, users can store, update, and retrieve data by name or through queries based on data values and conditions, cross-reference data in different files, and obtain information on various data base characteristics. Data processing operations can be performed through either a library of FORTRAN-callable subroutines, or through user-oriented command procedures at interactive terminals.

- Design Administration System – A capability which enables applications systems under CCSS to define, organize, control, and monitor major projects. For each project: (1) the set of valid users and files can be defined and organized; (2) access privileges for project, command procedures, and file usage can be established; (3) project activity can be recorded and used for administrative reports describing who worked on the project and when, the commands or tasks performed, significant events that occurred, and the accrued computer costs; and (4) the project can be terminated and removed from the system with all or some files optionally archived to magnetic tape.

Under NAVSEA's Computer-Aided Ship Design and Construction (CASDAC) project, several subsystems for ship design and construction are being planned and developed for operation using features of CCSS. ELXDAC is one of these subsystems.

The capabilities provided by CCSS will need to be designed for the general requirements and problems of an integrated system and are therefore independent of any particular application. Thus, the CCSS components in combination can be used to form an integrated system and tailored to a particular task. Alternatively, each CCSS component can be used for its own capabilities by individual applications.

ELXDAC SUPPORT SOFTWARE NO. 5

TITLE: LOAD ANALYSIS

a. Purpose and Objective

The program shall generate listings of the ship's electric power consuming equipment and compute and distribute evenly electric loads required for each of the three phases of the power, lighting and I.C. circuits. The program will use manually-generated data and data retrieved from ELXDAC catalogs. The program will produce a line-by-line listing of all consuming power equipment and their electrical loads for various ship operating conditions.

b. Scope

Current programs developed by industry and the Navy will be modified for this application.

c. Engineering

Input

- Contract Specification Data

- GFE/GFI Data

- Vendor Data

- Schematic Diagram Data

- Elementary Diagram Data

- Power System Deck Plan Data

- Lighting System Deck Plan Data

- Design Division Instruction Data

Output

- System Loads (3-phase)

d. Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e. Validation

The program will be tested against at least 5 hand calculations.

ELXDAC SUPPORT SOFTWARE NO. 6

TITLE: VOLTAGE DROP

a. Purpose and Objective

This program will perform voltage drop calculations based upon cable length and impedance along with system voltage level.

b. Scope

Current programs developed by Industry and the Navy will be modified for this application.

c. Engineering

Input

- Contract Specification Data

- Contract Guidance Drawing Data

- Ship Specification Data

- GFE/GFI Data

- Equipment Lists

- Vendor Data

- Elementary Drawing Data

- Isometric Drawing Data

- Power System Deck Plan Data

- Lighting System Deck Plan Data

- Design Division Instruction Data

Output

- Voltage Drop Analysis

d. Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e. Validation

The program will be tested against at least 5 hand calculations.

f.   References

   • Design Data Sheet DDS-9620-2 Electric Cable Voltage Drop Calculations

ELXDAC SUPPORT SOFTWARE NO. 7

TITLE: FAULT CURRENT

a. Purpose and Objective

This program shall perform fault current analysis using the power system elementary wiring diagram, known characteristics of the SSG's, estimated characteristics of the operating motors, feeders, bus ties, and circuit breakers.

b. Scope

Current programs developed by Industry and the Navy will be modified for this application.

c. Engineering

Input

- Contract Specification Data

- Contract Guidance Drawing Data

- Ship Specification Data

- GFE/GFI Data

- Equipment Lists

- Vendor Data

- Elementary Drawing Data

- Isometric Drawing Data

- Power System Deck Plan Data

- Lighting System Deck Plan Data

- Design Division Instruction Data

Output

- Fault Current Analysis

d. Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e. Validation

The program will be tested against at least 5 hand calculations.

f. References

- Design Data Sheet DDS-9620-3 Fault Current Calculations

ELXDAC SUPPORT SOFTWARE NO. 8

TITLE: LOAD SHEDDING

a. Purpose and Objective

This program shall determine the sequencing of all consuming power equipment shut down in order to minimize loads during casualty conditions.

b. Scope

This program will evolve in two phases:

(1) Development of the engineering procedures to meet the purpose and objectives.

(2) Development of a computer program utilizing the engineering procedure.

c. Engineering

Input

- Contract Specification Data

- Load Summary Data

- Isometric Drawing Data

- Design Division Instruction Data

Output

- Shutdown instructions

d. Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e. Validation

The program will be evaluated against past designs.

ELXDAC SUPPORT SOFTWARE NO. 9

TITLE: SYNCHRO LOAD ANALYSIS

a.   Purpose and Objective

This program shall determine the quantity of synchro signal amplifiers required to support control and torque signal loads.

b.   Scope

This program will evolve in two phases:

(1)   Development of the engineering procedures to meet the purpose and objectives.

(2)   Development of a computer program utilizing the engineering procedure.

c.   Engineering

Input

- Contract Specification Data

- Contract Guidance Drawing Data

- Ship Specification Data

- GFE/GFI Data

- Vendor Data

- Schematic Diagram Data

- Elementary Wiring Diagram Data

- Isometric Drawing Data

- Design Division Instruction Data

Output

- Syncro Load Analysis

d.   Data Base Support

No special data base, other than a library of synchros and synchro amplifiers which will be developed initially, will be required.

e.   Validation

The program will be evaluated against past designs and the manual method.

f. References

   • Design Data Sheet DDS-9650-2 Synchro Load Calculations

   • NAVSHIPS Standard Drawing 815-1853311 Synchro Load Calculations

ELXDAC SUPPORT SOFTWARE NO. 10

TITLE: DEGAUSSING CALCULATIONS

a.   Purpose and Objective

This program shall determine the calculations that are required for the determination of the degaussing cable circular mil area. This includes calculations of amperage per loop and the total amperages for the purpose of sizing the power supplies. Placement of coils also shall be determined by this program.

b.   Scope

The current NAVSEC degaussing program will be revised for this application.

c.   Engineering

Input

- Contract Specification Data

- Contract Guidance Drawing Data

- Ship Specification Data

- GFE/GFI Data

- Vendor Data

Output

- Degaussing Calculations

- Coil placement

d.   Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e.   Validation

The program will be tested against at least 5 hand calculations.

ELXDAC SUPPORT SOFTWARE NO. 11

TITLE: ILLUMINATION ANALYSIS

a.   Purpose and Objective

This program shall determine the locations in each compartment in which foot-candle illumination levels are to be obtained.

b.   Scope

This program will evolve in two phases:

(1)   Development of the engineering procedures to meet the purpose and objectives.

(2)   Development of a computer program utilizing the engineering procedure.

c.   Engineering

Input

- Contract Specification Data

- Lighting System Deck Plan Data

- Vendor Data

- Isometric Drawing Data

- Design Division Instruction Data

Output

- Illumination Survey Drawing

d.   Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e.   Validation

This program will be evaluated against past designs and the manual method.

ELXDAC SUPPORT SOFTWARE NO. 12

TITLE: HVAC ANALYSIS

a. Purpose and Objective

This program will determine cooling, heating and dry-air requirements for electrical/electronic equipment.

b. Scope

This program will evolve in two phases:

(1) Development of the engineering procedures to meet the purpose and objectives.

(2) Development of a computer program utilizing the engineering procedure.

c. Engineering

Input

- Contract Specification Data

- GFE/GFI Data

- Vendor Data

- Arrangement of Electrical/Electronic Spaces

- Isometric Drawing Data

- Design Division Instruction Data

Output

- Heating, ventilation and air-conditioning requirements for electrical/ electronic equipment and spaces.

d. Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e. Validation

This program will be evaluated against past designs and the manual method.

ELXDAC SUPPORT SOFTWARE NO. 13

TITLE: EMI/GROUNDING AND CABLE SEPARATION REQUIREMENTS ANALYSIS

a. Purpose and Objective

This program shall determine shielding and separation requirements for low-level signal cables. Proper bonding techniques for grounding of cable sheaths and equipment will also be an output of this program.

b. Scope

This program will evolve in two phases:

(1) Development of the engineering procedures to meet the purpose and objectives.

(2) Development of a computer program utilizing the engineering procedure.

c. Engineering

Input

- Contract Specification Data

- *Ship Specification Data*

- Vendor Data

- Design Division Instruction Data

Output

- EMI/Grounding Instructions

- Cable Shielding and Separation Requirements

d. Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e. Validation

This program will be evaluated against past designs and the manual method.

ELXDAC SUPPORT SOFTWARE NO. 14

TITLE: WEIGHT AND MOMENT ANALYSIS

a. Purpose and Objective

The purpose of this program is to calculate moments and summarize weights and moments from detail data which is supplied by the user.

b. Scope

The current NAVSEA ship design weight estimate program shall be modified for this application.

c. Engineering

Input

- Contract Specification Data

- Contract Guidance Drawing Data

- GFE/GFI Data

- Vendor Data

- Equipment Lists

- Cableway Layout Data

Output

- Weight and Moment Estimates

d. Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e. Validation

This program will be checked against a minimum of 5 hand calculations.

ELXDAC SUPPORT SOFTWARE NO. 15

TITLE: CW-2 PROGRAM (HOOK-UP)

a. Purpose and Objective

This program shall generate hook-up lists which aid the shop mechanic to per-
form the tasks of installing, hooking-up, testing and repairing electrical/electronic
shipboard systems.

b. Scope

Current programs developed by Industry and the Navy will be modified for this
application.

c. Engineering

Input

- Contract Specification Data

- Contract Guidance Drawing Data

- GFE/GFI Data

- Equipment Lists (GFI)

- Vendor Data

- Elementary Drawing Data

- Schematic Drawing Data

- Isometric Drawing and List of Materials Data

- Design Division Instruction Data

- EMI/Grounding Requirements Data

Output

- Hook-Up Lists

d. Data Base Support

No special data base, other than that which is incorporated in the pro-
gram, will be required.

e. Validation

This program will be evaluated against the manual method.

ELXDAC SUPPORT SOFTWARE NO. 16

TITLE: CABLE HEAT DISSIPATION ANALYSIS

a. Purpose and Objective

This program shall determine cable heating dissipation within wireways with the use of cable de-rating factors and modify, if necessary, existing cable routes and sizes.

b. Scope

This program will evolve in two phases:

(1) Development of the engineering procedures to meet the purpose and objectives.

(2) Development of a computer program utilizing the engineering procedure.

c. Engineering

Input

● Contract Specification Data

● Wireway Drawing Data

● Cable Data

Output

● Cable heating dissipation

● Modified cable routes

● Modified cable sizes

d. Data Base Support

No special data base, other than a library of cable characteristics, will be required.

e. Validation

This program will be evaluated against the manual method.

ELXDAC SUPPORT SOFTWARE NO. 17

TITLE: CABLE ROUTING

a. Purpose and Objective

This program shall generate cable route numbers, penetration numbers and determine locations and dimensions of main cableways. A reference table of transit assignments to cables and sizing of transits for bulkhead penetrations will also be accomplished by this program.

b. Scope

This program will evolve in two phases:

(1) Development of the engineering procedures to meet the purpose and objectives.

(2) Development of a computer program utilizing the engineering procedure.

c. Engineering

Input

- Contract Specification Data

- Design Division Instruction Data

- Cable Catalogs

- EMI/Grounding/Cable Separation Requirements

- Wireway Drawing Data

Output

- Cable route numbers

- Penetration numbers

- Locations and dimensions of main cableways

- Transit sizes and cable assignments

d. Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e. Validation

This program will be evaluated against the manual method.

ELXDAC SUPPORT SOFTWARE NO. 18

TITLE: CABLE/CABLEWAYS ESTIMATES

a.   Purpose and Objective

This program shall estimate total ship requirements for various cable sizes and types. This program will also determine the number of cableways required for the construction of the ship.

b.   Scope

This program will evolve in two phases:

(1)   Development of the engineering procedures to meet the purpose and objectives.

(2)   Development of a computer program utilizing the engineering procedure.

c.   Engineering

Input

● Contract Specification Data

● Contract Guidance Drawing Data

● Preliminary System Sketches

● GFE/GFI Data

● Preliminary Load Summary Data

● Preliminary Fault Current Data

● Preliminary Voltage Drop Data

Output

● Cable estimates

● Number of cableways

d.   Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e.   Validation

This program will be tested against past designs and the manual method.

ELXDAC SUPPORT SOFTWARE NO. 19

TITLE: ANTENNA MODELING

a. Purpose and Objective

This program utilizes the numerical technique known as the "method of moments" to predict radiation patterns and impedances of antennas. The most feasible location of antennas is also determined.

b. Scope

The current MBA antenna modeling program, available from NAVSEA, will be revised for this application.

c. Engineering

Input

• Geometrical description of the antenna

• The antenna's environment in the form of a wire grid

• Antenna excitation parameters

Output

• Antenna radiation patterns

• Antenna impedances

• Antenna placement

d. Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e. Validation

The program will be tested against at least 5 hand calculations.

ELXDAC SUPPORT SOFTWARE NO. 20

TITLE: COMBAT SYSTEM MODELING

a. Purpose and Objective

This program generates various summaries relating to the effectiveness of a ship's combat system and crew to respond to different threats. This enables the engineer or designer to select the most feasible combat system suite that best serves the mission of the ship.

b. Scope

The current combat system modeling programs, available from NAVSEA, will be revised for this application.

c. Engineering

Input

- Ship and Target Initial Conditions

- List of Weapons Direction System Operators

- List of Equipment

- Coded Form of Operational Sequence Diagrams

Output

- Summaries relating to the effectiveness of the ship's combat system and crew to respond to different threats

- Realistic assessment of the capabilities of large, complex, interactive ship systems

d. Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e. Validation

This program will be evaluated against past designs and manual techniques.

ELXDAC SUPPORT SOFTWARE NO. 21

TITLE: DECK LIGHTING

a. Purpose and Objective

This program shall generate data showing lighting distribution from distribution panels to lighting fixtures and appliances in accordance with arrangement drawings.

b. Scope

This program will evolve in two phases:

(1) Development of the engineering procedures to meet the purpose and objectives.

(2) Development of a computer program utilizing the engineering procedures.

c. Engineering

Input

- Contract Specification Data

- C & A Drawing Data

- Vendor Data

- Machinery Arrangement Drawing Data

- Arrangement of Major Electronic Spaces Data

- Sizing of Components Data

- Preliminary Cableway Layout Data

- Isometric Drawing Data

Output

- Lighting Distribution

d. Data Base Support

No special data base, other than that which will be incorporated in the program, will be required.

e. Validation

This program will be evaluated against past designs and manual techniques.

ELXDAC SUPPORT SOFTWARE NO. 22

TITLE: EQUIPMENT LISTS AND SUMMARIES

a. Purpose and Objective

This program shall generate various summaries and equipment lists as deemed necessary by the designer or engineer.

b. Scope

The current NAVSEA electronic list and support requirements program will be revised for this application.

c. Engineering

Input

● Summaries as required

● Equipment nomenclature and attributes

Output

Reformatted--

● Summaries

● Equipment lists and attributes

d. Data Base Support

No special data base, other than a data base containing shipboard electronic equipment with specific attributes which will be incorporated in the program, will be required.

e. Validation

This program will be evaluated against manual techniques.

ELXDAC SUPPORT SOFTWARE NO. 23

TITLE: DRAFTING PACKAGE - 2-D

a.   Purpose and Objective

To provide a drafting capability to prepare two-dimensional drawings that are required in the electrical process:

- electrical drawings - contract design

- electrical drawings - detail design

- background for electrical composite drawings (structure, ventilation, etc.)

- background for electrical arrangement drawings (structure, ventilation, etc.)

- label plates

This software shall also have the capability of being a general drafting tool for the preparation of diagrams for other systems - heating, ventilation, air conditioning, piping, etc. It shall also be a general drafting tool for creating line drawings of any type.

b.   Scope

The program will evolve in two phases:

(1) A detail definition of the engineering requirements of the drafting program to meet the purpose and objective.

(2) Development of the computer program to meet the requirements of the detail definition.

c.   Engineering

Input

- X,Y location coordinates of line, curve, representations

- identifiers of electrical components

- option to specify line widths and colors

Transform

The following capabilities should be part of the program.

(1) 2-D modeling capability

- model can be updated, revised, edited

- model can be edited at a CRT device

- capability to indicate non-connectivity of crossing lines

- automated labeling

- capability to draw solid, dash, dash dot, centerline, and other type lines required by the standards

- ability to segment the drawing into prescribed lengths

- modify scale of drawing

- create title block and borders

- create text (notes, references, titles)

(2) General drafting capabilities to prepare line drawings of any type not related to a model. For ELXDAC, this capability would be used to draw ship background in support of ELXDAC Support Software No. 24 - Drafting Package - 3-D. This background will be comprised of ship structure, machinery, ventilation ducts, piping, etc., extracted from drawings of these systems.

d. Computer Program

The computer program shall be utilized in a data reduction and drafting station comprised of:

- a digitizer with free moving cursor and table about 4' x 5' for input

- a disk file for storage of programs and library data

- a CRT storage tube for editing and viewing of input data

- a plotting device for preparation of drawings

- a teletype terminal for inputting data

- a card punch for recording input

- a tape deck for recording input

- a minicomputer for minor processing

- a minicomputer interface with a main frame for major processing

The software for plotter interface shall utilize CALCOMP format subroutine calls. Other software shall be ANSI standard FORTRAN.

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ELXDAC SUPPORT SOFTWARE NO. 24

TITLE: DRAFTING PACKAGE - 3-D

a.   Purpose and Objective

     To provide a drafting capability to prepare three-dimensional drawings that
are required in the electrical process:

- arrangement drawings

- cable hanger and support arrangement drawings

- cable hanger and support detail drawings

- cableway arrangement drawings

- cableway detail drawings

     This software shall also be adaptable to provide a drafting capability for the
preparation of other network type systems such as heating, ventilation, air condi-
tioning, and piping systems.

b.   Scope

     The program will evolve in two phases:

     (1) A detail definition of the engineering requirements of the drafting pro-
gram to meet the purpose and objective.

     (2) Development of the computer program to the requirements of the detail
definition.

c.   Engineering

     Input

- X,Y,Z location coordinates of electrical components from a specified origin

- identifiers of electrical components

- centerline run of cables/cableways identified by X,Y,Z coordinates from
  origin at intersection points

- option to specify line widths and colors

     Transform

     The following capabilities should be part of this program.

     (1) 3-D modeling capability

- model can be updated, revised, edited

- model can be edited at a CRT device

(2) Create orthogonal views - plan, section, elevation

(3) Ability to create, store, and retrieve templates

(4) True hidden-line capability (not manual input)

(5) Automated dimensioning capabilities

(6) Automated labeling capabilities

(7) Ability for user to cut through a view with a plane to create a new plan, section, elevation

(8) Same as (7) above for a jagged plane

(9) Ability for user to select part of an arrangement to create an electrical assembly

- by cards

- by CRT

(10) Ability for user to segment a drawing into prescribed lengths (for microfilm aperture cards)

(11) Modify scale of drawing

(12) Create secondary auxiliary views

(13) Create title block and borders

(14) Rotate stored model in any plane and provide plan, section, and elevation views

(15) Provide isometric views

(16) Provide oblique views from any vantage point

(17) Provide exploded views (oblique, isometric)

(18) Provide perspective views

(19) Provide depth scissoring

(20) Create test (notes, references, titles)

Output

- electrical arrangement drawing

- cable hanger arrangement drawing

- cable hanger detail drawing

- cableway arrangement drawing

- cableway detail drawing

All of the above drawings may be composed in standard othogonal view (plan, section, and elevation) or to the various other type views specified under Transform.

d.   Computer Program

The computer program shall be utilized in a data reduction and drafting station comprised of:

- a digitizer with free-moving cursor and table about 4' x 5' for input

- a disk file for storage of programs and library data

- a CRT storage tube for editing and viewing of input data

- a plotting device for preparation of drawings

- a teletype terminal for inputting data

- a card punch for recording output

- a tape deck for recording output

- a minicomputer for minor processing

- a minicomputer interface with a main frame for major processing

The software for plotter interface shall utilize CALCOMP format subroutine calls.   Other software shall be ANSI standard FORTRAN.

e.   Data Base Support

- A library of variable templates of electrical components which comprise suitable geometry for drafting purposes and to meet the needs of the various type views to be created as output when preparing electrical arrangement and detail drawings.

- A library of templates of cable hanger components for the preparation of cable hanger arrangement and detail drawings.

- A library of title blocks and borders.

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● A library of commonly used notes and references.

● Review the following and provide extractions for a library support data:

MIL-STD-8C	– Dimensioning and Tolerances (Inactive – Use USASI) 14.5 – 1966.
MIL-STD-12	– Abbreviations for Use on Drawings and in Technical Type Publications.
MIL-STD-806	– Graphical Symbols for Logic Diagrams

f. Validation

The features of the program shall be exercised to create one sample of each of the following:

● arrangement drawing

● cable hanger and support arrangement drawing

● cable hanger and support detail drawing

● cableway arrangement drawing

● cableway detail drawing

All possible types of views shall be generated for each of the above drawings including:

● orthogonal

● rotated views

● isometric views

● oblique views from any vantage point

● exploded views (oblique, isometric) or hanger and cableway details

● perspective views

● depth scissoring

Specifically, the following are some of the features to be exercised:

(1) A template library of electrical components

(2) Orthogonal plan view

(3) Orthogonal elevation view looking to starboard

(4) Orthogonal elevation view looking to port

(5) Orthogonal section view looking forward

(6) Orthogonal section view looking aft

(7) Provide above orthogonal views not in plane or principal axis

(8) Provide dimensions and labels

(9) Cut a plane through the plan view athwartship and provide a section view looking aft and a section view looking forward

(10) Cut a plane through the centerline of ship in plan view and provide an elevation looking to starboard and an elevation looking to port

(11) Cut a jagged plane (offset plane) in the plan view athwartship and provide a section looking aft and a section looking forward

(12) Segment the drawing to some prescribed lengths (say, every scaled 3 feet)

(13) Change the scale in one view and produce another drawing to a new scale (say 1/2" = 1 ft to 1/4" = 1 ft.)

(14) Create an isometric drawing of the arrangement

(15) Create several oblique views from different vantage points looking down and up on the network

(16) Draw the title block and border for one of the plan elevation and section views

(17) Create a depth scissoring of the plan, elevation, and section

(18) Create an exploded view

g. References

(1) General Specifications for Ships of the U.S. Navy, NAVSHIPS 0902-001-5000.

(2) MIL-D-1000 - Drawings, Engineering and Associated Lists.

(3) MIL-STD-100 - Engineering Drawing Practices.

(4) MIL-D-5480 - Data, Engineering and Technical; Reproduction Requirements for.

ELXDAC SUPPORT SOFTWARE NO. 25

TITLE: INTERFERENCE DETECTION

a. Purpose and Objective

To detect the interferences of ship components which involves:

- ship components do not physically interfere

- clearance for operation and maintenance is obtained

- conformance with design rules, viz:

    •• steam lines do not pass over electrical equipment

    •• heat clearance is maintained

    •• access clearance is maintained

b. Discussion

To be effective, an interference program must be used within the context of a totally integrated computer-based system: structures; piping; electrical/electronic; heating, ventilation and air-conditioning; machinery.

Therefore, a stand-alone interference program should be used to permit the modeling of all the systems.

Initial work in this area was done by the Navy, reference (1), but development is required to meet the purposes and objectives stated in paragraph a.

c. Abstract of Navy Program

The computer program for detecting physical interferences between ship systems has been developed to help minimize the costly, time consuming expense of correcting design errors which are undetected until the construction stage. Ship systems are modeled in terms of basic geometric shapes (box, cylinder and sphere), called "primitive shapes," which are analytically tested for interferences. A listing of interferences and a plot is provided to assist the designer in modifying his design in the ship spaces where space conflict problems exist.

d. Data Base and Software Support

To facilitate generation of an interference model, it is essential that a data base exist containing geometric data for components, and a component software file be available for generating a variable dimension primitive shape model for each type component. The primitive shape dimensions of the model are retrieved from the data base to suit the size of the component used. The availability of a data base and software support will eliminate repetitious user input needed to describe components which are used repeatedly.

e.   References

(1) Interference Detection of Naval Ship Systems by Computer, Progress Report, by Gerald Gerstel and Thomas Poitras, NSRDC, CMD Technical Note, CMD-14-73, February 1973.

(2) Interference Control System by J. K. McNeal, R. P. Kakad and J. S. Magrie - Sun Shipbuilding and Dry Dock Company presented at the 22 February 1973 meeting of the Delaware Valley Section of the American Society of Naval Engineers.

ELXDAC SUPPORT SOFTWARE NO. 26

TITLE: FILE SEARCH/QUERY

a. Purpose and Objective

    To provide the ELXDAC user with a facility for rapid retrieval of information
and data that is stored on a file. The file contains data stored on microfilm/
microfiche type media that is not machine-readable, but which is available for dis-
play on a remote video unit and which may be transformed to hard copy. Retrieval
from the file of specific data will be achieved by specifying a location index,
such as a frame and/or reel number, of the desired data.

    The purpose of this software package is to develop a procedure for obtaining a
specific location index by addressing the total file index, that is stored in digi-
tal model, with queries and key words.

    This software shall also be adaptable for other CASDAC systems.

b. Scope

    This software development would be used in conjunction with ELXDAC software
item number 28. The initial effort in this development will be identification of
the type data to be stored on the file and how this data will be subdivided for
the retrieval purposes. This will be followed by the development of a retrieval
program which permits the user to retrieve location indexes of selected portions
of the stored data. For example, "Retrieve-index number(2) of - Arrangement
drawing, Sonar System, main deck, - aft of Frame 51". A typical reply to this
query could be "Reel number 32, frame 12, 13 and 14".

c. Engineering

    Input

    ● Type of stored data - (e.g., Vendor Drawing)

    ● Specific data (e.g., IC System)

    ● Modifier 1 (e.g., Switchboard)

    ● Modifier 2 (e.g., Circuit Breakers)

    Output

    ● Reel number(s)

    ● Frame number(s)

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ELXDAC SUPPORT SOFTWARE NO. 27

TITLE: AUTOMATIC LABELING

a. Purpose and Objective

To provide a capability to automatically place labels and dimensions on compu-
ter-generated drawings in an organized manner and which will later be edited by in-
teractive means to avoid interference with delineated objects and for clarity.

This software shall also be adaptable to provide automatic labeling for other
CASDAC systems.

b. Scope

This software development would be used in conjunction with ELXDAC software
items numbers:

23 - Drafting Package 2-D

24 - Drafting Package 3-D

These software packages are used in the preparation of several types of elec-
trical drawings.

c. Description of Program

● Placement of Labels

This program shall be developed to contain algorithms that will automati-
cally place an arrowhead, an extension line, and a reserved space for a label for
all electrical components that are specified on an electrical drawing. Where
electrical components are closely grouped the program will align the labels in
like groups. The objective is to avoid random scattering of labels where possible.

● Label Notation

The actual label (e.g., CKT-IMC, R-DD1) shall be automatically generated
from a label library and placed in the reserved space. The user shall have a means
of interacting with the program to indicate which components have the same label
number.

● Placement of Dimensions

The program will contain algorithms to place extension lines and arrowed
dimension lines to the extension lines for all applicable electrical components as
they normally appear on the electrical drawings. The user may insert a dimension
value by means of a keyboard or digitizer menu pick. The space for the dimension
value should not overlay the electrical component.

d. References

   ● Electrical drawings

e. Guidance

   The reference given in paragraph "d" above is to provide guidance in the development of this software.

ELXDAC SUPPORT SOFTWARE NO. 28

TITLE: COM FOR LABELING

a.   Purpose and Objective

To provide a computer output microfilm program for use in preparing film nega-
tives of label plates and file records for the Ship Master File.

This software shall also be adaptable to provide label plates for other CASDAC
systems.

b.   Scope

This software development would be used in support of ELXDAC Stand-Alone Sub-
system M - Label Plates. The initial development of this COM capability will be
limited to the capability to prepare the film negatives for label plates.

c.   Description of Label Plates

The general capability of this software should encompass the recording of label
plate and information plate descriptions in digital form on microfilm. The images
will include alphanumeric and diagram-type data. The developed microfilm will then
be processed through an automatic plate-making device to create a full-size negative
for the preparation of label plates and information plates. Plate-making equipment
of this type can produce up to 800 plates per hour in sizes from 9" x 12" to
20" x 24".

d.   Scope

This software development will involve that required to generate the label
plate images on to the microfilm. Any software required to process the microfilm
to produce the label plates is not included in this development.

e.   References

(1) Typical ELXDAC Label Plate Drawings

f.   Guidance

Reference (1) provides examples of the label plates to be produced by this
program.

ELXDAC SUPPORT SOFTWARE NO. 29

TITLE: REPORT GENERATOR/EDITOR

a. Purpose and Objective

   To provide a user with the capability of producing a computer-generated report
of information contained in a digital model in a format to suit the needs and
requirements of his organization.

   This software shall be general enough so that it can be adaptable for other
CASDAC systems and should be part of the Central Control System Software. Indi-
vidual report formats will be generated by developing applicable software modules.

b. Scope

   The program should have two basic capabilities:

   (1) Storage and retrieval of standard formats that may be used on a recur-
        ring basis. Such formats would be:

        ● Lists of material and associated title blocks, notes, references, bor-
          ders, etc. Such lists are made for arrangement drawings and label
          plates.

        ● Ship test specifications

        ● Ship test reports

        ● Consolidated lists (cable list, connector list)

        ● Lists of drawings

        ● Interface data

        ● Etc.

   (2) Generation of new formats of data to meet the needs of a new or unique re-
        quirement. These formats are associated with a query capability. Exam-
        ples:

        ● A list of all cables in a compartment

        ● A list of all cables in a compartment with connectors

        ● A list of compartments with cables

        ● A list of compartments with cables having connectors

c. General Description

(1) The production of a report requires:

(a) Definition of the output

• Names of items to be printed

• *Format* - page headings, *row and column headings*, vertical and horizontal spacing, paging, footnotes, etc.

(b) Definition of a subset of the record in the Ship Master File that will provide the data for the report

(c) Using (1) and (2), possibly some manual inputs to print the report on one of several output devices

(2) Report Definition

• The user defines the report specification at report-generation time.

• A separate program to define report specifications is stored in the data base, either in a defined or in a coded form available to the user.

• Both of the above may be allowable; a report definition module within a report generation program and a separate report definition program.

(3) Producing the Data to be Reported

• The user enters a query into an existing query processor, producing a "hit" file for use in a subsequent report generator command.

• The query processor may be linked directly to the report generator, i.e., the report generator would be developed as a module of the existing query processor.

• The query condition may be defined and stored as part of the report definition.

• All of the above are to be accommodated.

(4) Report Generation

Steps (a) and (b) from paragraph C (1) may produce a file of a specific format to be processed by an existing report generator program, thus eliminating part of the development time and cost.

The report generation program may be an original development.

d.   References

Design of the Comrade Data Management System Query/Report Subsystem, Final
Report, June 1975, ONR, Prepared by Ocean Data Systems, Inc., Rockville,
Maryland

e.   Guidance

Before preparation of the specifications for this program, a review should
be made of the above reference.

A possible approach for the development of this program could consist of
three phases.

PHASE 1 - Design and development of a report definition program to create
and store report specifications to be used subsequently by the report generator
program. A report generator program would produce a report given a stored report
specification and a reference to the Ship Master File. The report generator
would not be linked to the query processor. The report definition would identify
the block type (or subset) containing the data to be represented in the report,
and the report generator would retrieve and format the output for all blocks of
that type.

PHASE 2 - Modification of a query processor to produce as a hit file a data
base to be used by the report generator program developed in Phase 1. The data
blocks on this file would contain only the information necessary to the genera-
tion of the report; hence new block types (subsets of the ones on the original
data base) might be created. The query processor and the report generation
program would be linked together in a command procedure in order to simplify the
user interface.

PHASE 3 - The report definition language would be expanded to include the
specification of retrieval conditions, thereby further reducing the required user
interfaces.

V. ELXDAC DATA BASE (continued)

B. LEVEL IV DESIGN DATA BASE (continued)

2. Catalog Data

The following catalogs will be a part of the ELXDAC system:

C-1 Master ELXDAC Catalog File

C-2 Schedule A (GFE)

C-3 Catalog of Electrical Symbols

C-4 Ship Contract Specifications

C-5 Design Data Sheets

C-6 Cable Hanger Data

C-7 Test Procedure Library

C-8 2D-Component Description (Graphics)

C-9 3D-Component Description (Graphics)

C-1 (Master ELXDAC Catalog File)

Purpose and Objective

The Master Catalog File (MCF) to be assembled in support of ELXDAC comprises all of the data specified as catalogs, design guidelines, and design data. The MCF is divided into subset catalogs for reference to specific catalogs in the ELXDAC subsystems. These subset catalogs are made up of the above catalogs and the design guidelines and design data.

The following catalogs are also subsets of the Master Catalog File:

1. Electric Power Generation Equipment

2. Power Distribution Switchboards

3. Power Distribution System (Cable)

4. Lighting System (Distribution and Fixtures)

5. Electric Plant Repair Parts

6. Navigation Equipment (Non-Electronic)

7. Interior Communication Systems and Equipment

8. Gun Fire Control System

9. Countermeasure Systems (Non-Electronic)

10. Electronic Countermeasure System (ECM)

11. Missile Fire Control System

12. ASD Fire Control and Torpedo Fire Control Systems (Surface Ship)

13. Torpedo Fire Control System (Submarines)

14. Radar Systems

15. Radio Communication Systems

16. Electronic Navigation Systems

17. Space Vehicle Electronic Tracking
    Systems

18. Sonar Systems

19. Electronic Tactical Data System

20. Communication and Control Repair
    Parts

C-2 Schedule A (GFE)

Purpose and Objective

    To provide a catalog which will contain a list of all the Schedule A (GFE) items used in the design of electrical/electronic systems and shown on electrical drawings.

C-3 Catalog of Electrical Symbols

Purpose and Objective

To provide a catalog which will contain a two-dimensional representation of symbols used in the design of electrical systems and as shown on electrical drawings.

Scope

These symbols must be suitable for reproduction by automated plotting and drafting machines. The final set of symbols will be submitted to the ELXDAC Advisory Committee for approval.

C-4 Ship Contract Specifications

Purpose and Objective

    To provide a means of determining the contents of a ship contract specification as it relates to the preparation of electrical drawings, label plates and test specifications.

Scope

    A typical ship will be selected and the data will be structured in digital form to support the preparation of:

- All electrical drawings

- All label plates

- All electrical system test procedures

    The structure of this file will provide a guide for the preparation of similar files for other ships that will be under construction in the future.

C-5 Design Data Sheets

Purpose and Objective

To provide a catalog that will contain design data sheets for calculations
needed for the Scientific and Engineering subsystem. Voltage drop, fault current,
and synchro load analysis' calculations are determined with the use of design
data sheets.

C-6 Cable Hanger Data

Purpose and Objective

   To provide a catalog which will contain cable hanger data. Data such as cable hanger sizes, types, loads and weight will be part of this catalog.

C-7   Test Procedure Library

Purpose and Objective

To provide a library of text of standard test procedures associated with the electrical/electronic systems.

To provide an index and applicability reference of process instructions associated with the electrical/electronic systems.

Scope

The test procedures and the process instructions of a selected shipyard will be used in the development of this library. Other shipyards will utilize this library to develop their own data base.

C-8/C-9 2-D/3-D - Component Description (Graphics)

Purpose and Objective

To provide a catalog of the 2-D/3-D geometric characteristics of electrical/
electronic equipment and components for use in developing arrangements, weights
and moments, mock-ups, etc.

B. LEVEL IV DESIGN DATA BASE (continued)

3. Design Guidelines

The design guidelines used by the ELXDAC system will consist of the following documentation and follow the format of previous text type catalogs.

C-10 Equipment Standards (MIL-E-16400, MIL-STD-454, MIL-E-917, MIL-I-983)

C-11 System Installation Standards (NAVSHIPS 0964-000-2000, 0981-052-8130)

C-12 Cable Standards (MIL-C-915, 2194, 2320, 21609, 24145, MIL-W-16878)

C-13 Drawing Standards (MIL-STD-100, MIL-D-1000, MS-1662)

C-14 Symbol and Abbreviation Standards (ABC-STD-28, NAVSHIPS 0960-000-4000)

C-15 Label Standards (MIL-STD-195, MIL-P-15024)

C-16 Manual/Handbook Standards (MIL-T-005474, MIL-H-5474, MIL-M-15071)

C-17 EMI/Grounding/Safety Standards (MIL-STD-1310)

4. Design Data

The design data used by the ELXDAC system will consist of the following drawings, data and schedule. This information will follow the format of previous type catalogs and be a part of the Master ELXDAC Catalog Files.

C-18 Structural Steel Drawings & Data

C-19 Master Ship Construction Schedule

C-20 Historical Data (Past Designs)

C-21 Information from Level III & Other Disciplines

C-22 Space Arrangements and C & A's

The design data, like the catalog data and design guidelines, will be used in the development of the 10 ELXDAC subsystems.

VI. RELATIONSHIPS

A. DESCRIPTION OF RELATIONSHIPS

The ELXDAC system comprises 10 subsystems, 29 support software programs, 9 defined files of catalogs, 8 defined files of design guidelines, and 5 defined files of design data. The catalogs comprise several hundred attributes used to describe electrical components. The relationships between the subsystems, support software, and catalogs are considerably complex.

The purpose of this section is to illustrate the various relationships that exist between these major elements of the ELXDAC system so as to develop a rationale for preparing the "Schedule for Development," Section VII.

Table VI-1 is a matrix which identifies the various catalogs and design data described in Section V that are required to support each of the 10 subsystems described in Section IV. In some instances additional data will be required to support a particular subsystem, but the major files are identified in this matrix.

Table VI-2 is a matrix which identifies the various support software elements described in Section V that are required to support each of the 10 subsystems. Circles represent software common to other subsystems such as CAPDAC. Squares denote software peculiar to the ELXDAC subsystem.

Table VI-3 is a matrix which identifies the support software described in Section V that will normally be used in the design of each of the 15 electrical/ electronic systems. Circles represent software common to other subsystems such as CAPDAC. Squares denote software peculiar to the ELXDAC subsystem. Based on particular design criteria, in some instances a specified support software may not be used. On the other hand, support software not identified as applicable may be utilized. This matrix is based on normal expectations of application on either a surface ship or a submarine.

Table VI-4 is a matrix which identifies what ELXDAC subsystems will be used in the design of each of the 15 electrical/electronic systems for both surface ships and submarines. This matrix is based on normal expectations of application. Specification for a ship or other design criteria may change the utilization pattern shown in this matrix.

B. UTILIZATION OF THE RELATIONSHIP MATRICES

The relationship matrices will have a practical utility in the development of the ELXDAC system. The following examples illustrate this factor:

1. Development of Subsystem "E" Scientific and Engineering

   • Table VI-1 indicates that the following Catalogs, Design Guidelines, and
     Data Files will be required: C-5, C-12, and C-17. These elements are
     described in Section V.

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TABLE VI-1. ELXDAC SUBSYSTEMS VS. CATALOGS/DESIGN GUIDELINE AND DATA

CATALOGS/DESIGN GUIDELINES AND DESIGN DATA

ELXDAC SUBSYSTEMS	Level	INTERFACE	SHIP SPEC	DRAWINGS & MAT LIST	CABLING & WIRING	ARRANGEMENTS	MATERIAL CONTROL	SCIENTIFIC & ENGR	DOCUMENTATION	LABEL PLATES	TEST PROCEDURES
MASTER ELXDAC CATALOG FILES	1			●		●	●				
SCHEDULE A (GFE)	1	●		●		●	●				
CATALOG OF ELEC SYMBOLS	1			●							
SHIP CONTRACT SPECIFICATIONS	1		●	●						●	●
DESIGN DATA SHEETS	1		●					●			
CABLE HANGER DATA	1				●	●	●				
TEST PROCEDURE LIBRARY	1										●
2D-COMPONENT DESCRIPTION (GRAPHICS)	1			●		●					
3D-COMPONENT DESCRIPTION (GRAPHICS)	1					●					
EQUIP STDS (MIL-E-16400, MIL-STD 454, MIL-E-917, MIL-I-983)	2		●				●		●		●
SYS INSTALLATION STDS (NAVSHIPS 0964-000-2000, 0981-052-8130)	2		●	●	●						
CABLE STDS (MIL-C-915, 2194, 2320, 21609, 24145, MIL-W-16878)	2		●	●	●		●	●	●		
DWG STDS (MIL-STD-100, MIL-D-1000, MS-1662)	2		●	●	●	●				●	
SYMBOL & ABBR STDS (ABC-STD-28, NAVSHIPS 0960-000-4000)	2		●	●	●	●				●	●
LABEL STDS (MIL-STD-195, MIL-P-15024)	2		●							●	
MANUAL/HDBK STDS (MIL-T-005474, MIL-H-5474, MIL-M-15071)	2		●							●	
EMI/GRND/SAFETY STDS (MIL-STD-1310)	2		●	●	●			●			●
STRUCTURAL STEEL DWGS & DATA	3	●		●	●	●				●	
MASTER SHIP CONSTR. SCHEDULE	3			●	●	●	●		●		●
HISTORICAL DATA (PAST DESIGNS)	3	●		●	●	●					●
INFO FROM LEVEL III & OTHER DISCIPLINES	3	●		●		●					
SPACE ARRANGEMENTS AND C&A'S	3			●	●	●					

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TABLE VI-2. ELXDAC SUBSYSTEMS VS. SUPPORT SOFTWARE

SUPPORT SOFTWARE (APPLICATION PROGRAMS AND SPECIAL SYSTEM SOFTWARE PACKAGES)

Support Software	INTERFACE	SHIP SPEC	DWGS & MAT LIST	CABLING & WIRING	ARRANGEMENTS	MATERIAL CONTROL	SCIENTIFIC & ENGR	DOCUMENTATION	LABEL PLATES	TEST PROCESURES
CENTRAL CONTROL SYSTEM SOFTWARE (CCSS)	●	●	●	●	●	●	●	●	●	●
EXECUTIVE SYSTEM (PART OF CCSS)	●	●	●	●	●	●	●	●	●	●
DESIGN ADMINISTRATION (PART OF CCSS)	●	●	●	●	●	●	●	●	●	●
DATA MGT SYSTEM (PART OF CCSS)	●	●	●	●	●	●	●	●	●	●
LOAD ANALYSIS			■	■			■			■
VOLTAGE DROP			■	■			■			■
FAULT CURRENT			■	■			■			
LOAD SHEDDING							■	■		
SYNCHRO LOAD ANALYSIS			■				■			
DEGAUSSING CALCULATIONS			■	■	■		■		■	
ILLUMINATION ANALYSIS			■		■		■		■	
HVAC ANALYSIS					■		■			
EMI/GROUNDING & CABLE SEPARATION ANALYSIS			■	■			■			■
WEIGHT/MOMENT ANALYSIS			●	●	●		●			
CW-2 PROGRAM (HOOK-UP)			■	■			■		■	■
CABLE HEAT DISSIPATION ANALYSIS				■			■			
CABLE ROUTING			■	■	■		■		■	
CABLE/CABLEWAYS ESTIMATES				■	■	■	■			
ANTENNA MODELING			■		■		■			■
COMBAT SYSTEM MODELING							■			
DECK LIGHTING			■		■		■			■
EQUIPMENT LISTS AND SUMMARIES			■		■	■		■	■	
DRAFTING PACKAGE – 2D			●	●	●				●	
DRAFTING PACKAGE – 3D				●			●			
INTERFERENCE DETECTION				●	●		●			
FILE SEARCH/QUERY	●	●	●	●	●	●	●	●	●	●
AUTOMATIC LABELING			●	●	●				●	
COM FOR LABELING									●	
REPORT GENERATOR/EDITOR		●					●		●	●

● – Software common to other subsystems such as CAPRAC

■ – Software peculiar to the ELXDAC subsystem

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SUPPORT SOFTWARE (APPLICATION PROGRAMS AND SPECIAL SYSTEM SOFTWARE PACKAGES)

ELECTRICAL/ ELECTRONIC SYSTEMS	CENTRAL CONTROL SYSTEM SOFTWARE (CCSS)	EXECUTIVE SYSTEM (PART OF CCSS)	DESIGN ADMINISTRATION (PART OF CCSS)	DATA MGT SYSTEM (PART OF CCSS)	LOAD ANALYSIS	VOLTAGE DROP	FAULT CURRENT	LOAD SHEDDING	SYNCHRO LOAD ANALYSIS	DEGAUSSING CALCULATIONS	ILLUMINATION ANALYSIS	HVAC ANALYSIS	EMI/GROUNDING & CABLE SEPARATION ANALYSIS	WEIGHT/MOMENT ANALYSIS	CW-2 PROGRAM (HOOK-UP)	CABLE HEAT DISSIPATION ANALYSIS	CABLE ROUTING	CABLE/CABLEWAYS ESTIMATES	ANTENNA MODELING	COMBAT SYSTEM MODELING	DECK LIGHTING	EQUIPMENT LISTS AND SUMMARIES	DRAFTING PACKAGE – 2D	DRAFTING PACKAGE – 3D	INTERFERENCE DETECTION	FILE SEARCH/QUERY	AUTOMATIC LABELING	COM FOR LABELING	REPORT GENERATOR/EDITOR
POWER	●	●	●	●	■	■	■	■				■	■	●		■	■	■				■	●	●	●	●	●	●	●
LIGHTING	●	●	●	●	■	■	■	■			■	■	■	●		■	■	■			■	■	●	●	●	●	●	●	●
DEGAUSSING	●	●	●	●		■				■		■	■	●		■	■	■				■	●	●	●	●	●	●	●
PROPULSION CONTROL	●	●	●	●		■			■					●	■	■	■	■				■	●	●	●	●	●	●	●
ELEC ALARM & IND	●	●	●	●		■								●	■	■	■	■				■	●	●	●	●	●	●	●
NAV & SIGNAL LIGHTS	●	●	●	●		■								●		■	■	■			■	■	●	●	●	●	●	●	●
IC VOICE COMMUNICATIONS	●	●	●	●		■						■	■	●	■	■	■	■				■	●	●	●	●	●	●	●
VISUAL INTEG IC	●	●	●	●								■	■	●		■	■	■				■	●	●	●	●	●	●	●
IC SWITCHBOARD	●	●	●	●	■	■			■			■	■	●		■	■	■				■	●	●	●	●	●	●	●
MISSILE/GUNNERY	●	●	●	●		■						■	■	●	■	■	■	■		■		■	●	●	●	●	●	●	●
ELEX WARFARE	●	●	●	●		■			■			■	■	●	■	■	■	■	■	■		■	●	●	●	●	●	●	●
NAVIGATION	●	●	●	●		■			■			■	■	●	■	■	■	■	■	■		■	●	●	●	●	●	●	●
SONAR	●	●	●	●		■							■	●	■	■	■	■		■		■	●	●	●	●	●	●	●
RADIO COMMUNICATION	●	●	●	●		■						■	■	●	■	■	■	■	■			■	●	●	●	●	●	●	●
RADAR/IFF/NTDS	●	●	●	●		■			■			■	■	●	■	■	■	■	■	■		■	●	●	●	●	●	●	●

● – Software common to other subsystems such as CAPEAC

■ – Software peculiar to the ELXDAC subsystem

TABLE VI-4. ELXDAC SUBSYSTEMS VS. ELEC/ELEX SYSTEMS

ELXDAC SUBSYSTEMS	POWER	LIGHTING	DEGAUSSING	PROPULSION CONTROL	ELEC. ALARM & IND	NAV. & SIGNAL LIGHTS	IC VOICE COMMUNICATIONS	VISUAL INTEG. IC	IC SWITCHBOARD	MISSILE/GUNNERY	ELEX WARFARE	NAVIGATION	SONAR	RADIO COMMUNICATIONS	RADAR/IFF/NTDS
INTERFACE	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SHIP SPEC	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DRAWINGS & MAT LIST	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
CABLING & WIRING	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
ARRANGEMENTS	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
MATERIAL CONTROL	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SCIENTIFIC & ENGR	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DOCUMENTATION	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
LABEL PLATES	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
TEST PROCEDURES	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

- Table VI-2 indicates that support software items 1 through 21, 25, and 26 will eventually be required for a totally functional scientific and engineering subsystem. This software is described in Section V.

2. Development of a design procedure for an electrical system - Example: Power System

   - Table VI-3 indicates that support software items 1 through 8, 12, 13, 14, 16, 17, 18, and 22 through 29 will be required to design the power system in a totally integrated environment.

   - Table VI-4 indicates that all 10 stand-alone subsystems will eventually be used in designing a power system.

3. Utilization of an Application Program

   - Table VI-3 illustrates, for example, that item 11, Illumination Analysis, will be used only in the design of the Lighting System. However, item 12, HVAC Analysis, is used in the design of 12 of the 15 electrical/electronic systems and item 25, Interference Detection, is used for all electrical/ electronic systems.

4. Association of Computer Software With a Particular Class of Ship

   - Using Table VI-3 and a list of the electrical systems for a particular class or type of ship, the applicable software to be used in the design of the ship may be identified.

   - Table VI-4 could be used in a like manner to identify applicable subsystems.

VII. SCHEDULE FOR DEVELOPMENT

A. BACKGROUND

1. Phases of Development

In Section II of this analysis, <u>Objectives and Goals</u>, the development of ELXDAC in five phases is described:

Phase I — Perform an engineering analysis and define the programs to be developed. Divide the programs into four groups, each group to be of approximately equal level of effort and is to represent a priority level starting with the first group as first priority. Determination of priority shall take into account the following factors:

- cost benefits to be realized within the scope of the total electrical process

- nature and extent of the data base required to support the program

- interface requirements of the integrated ELXDAC system

- the needs of the shipbuilding community – private and naval – and design agents

Phase II — Develop, under contract, the first group of programs. As a minimum, collect and structure the data base necessary to support the programs.

Phase III – Develop group 2 programs.

Phase IV — Develop group 3 programs.

Phase V — Develop group 4 programs.

2. The Data Base

The data base comprises:

- application programs

- catalogs

- technical information

  - design guidelines

  - design data

  - planning/construction support data

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The application programs are described in Section V. In the main, they are of general-purpose use and not related to the specific requirements of any of the 15 electrical/electronic systems cited in Section VI.

The catalogs and technical information are, however, directly related to specific electrical/electronic systems. To develop this information in an orderly manner, the data for the systems could be developed for those related to specific ship types. For example, the following sequence of gathering the 15 electrical/ electronic data is a possibility.

- Ship A - Destroyer Type - Gas turbine

- Ship B - Submarines - Nuclear

- Ship C - Aircraft Carriers

- Remaining Systems

3.   Rationale for Priorities

In determining the recommended priority for Level IV design the overriding consideration will be:

- the needs of naval construction in both private and naval shipyards.

B.   BASIC RECOMMENDED PRIORITY IN PHASES OF DEVELOPMENT - LEVEL IV

The recommended priorities for the stand-alone subsystems and applications programs in four phases of development for Level IV will be determined by a Navy/ Industry ELXDAC Advisory Committee.

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